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RESIDUAL CHARGES OF CONDENSERS.

As will be seen from the abstract published elsewhere, the institute paper of Dr. Bedell and Mr. Kinsley deals with the soaking-in effect of dielectrics. Its conclusions bring out strongly the fact that the action of a condenser cannot be predicted in the absence of knowledge in regard to its previous history with reference to charges. The importance of this point in connection with delicate investigations is rendered apparent by the statement that in one case a condenser experimented on retained the effect of its past charges after being short circuited for a month. The numerous curves in this paper add very largely to the data bearing on condensers, and the *Transactions* receive an additional permanent value from being made the repository of such matter, which in the present instance may soon assume a practical importance from the more general adoption of condensers in alternating work. In the absence of an equivalent for a Royal or Philosophical Society or of an Institut de France in this country, the various professional societies perform a good office by thus fulfilling one of the functions of the old European bodies. It is not probable, either, owing to the modern specialization of science, that such an equivalent of an inclusive character will grow up here, so that it may be considered as one of the legitimate functions of the American Institute of Electrical Engineers to become the medium for the publication of the data of electrical investigations, even though of a purely scientific interest. Aside from the prestige that will thus be given, it cannot be known how soon a purely scientific matter may become one of practical importance.

ELECTRICITY IN BERLIN.

We print elsewhere some extracts from a book prepared for the benefit of the engineers present at the recent annual meeting of the German national engineering society at Berlin, which gives some interesting statistics in regard to the extent of the electric lighting, and of the telephone and telegraph systems of that city. It will be seen that Berlin is but little behind New York in electric lighting and in the use of the telephone, the number of incandescent lamps being 203,050, and of telephone subscribers, 23,420. The annual average coal consumption in the Berlin central stations is, as noted, surprisingly low, being only three pounds per horse power-hour of electrical energy delivered to the consumer. This is undoubtedly the result of the careful study from an engineering standpoint to which every detail of central station design is submitted in Europe, and which is in striking contrast to the methods formerly the rule in the United States and not yet entirely obsolete. As we have before remarked in these columns, one reason for the general inferiority of our central stations to those of Europe has been the policy of not employing an engineer when laying down a plant, but depending almost entirely for the design upon the manufacturing company supplying the machinery. Such a system, owing to competition, results in only questions of first cost being given weight, for, when the sale of a plant depends only upon this factor, it would be folly, from a business standpoint, for the seller to increase the amount of his bid by the introduction of details involving superior efficiency that could not be appreciated by the ordinary purchaser. It is singular to note that the Morse recorder is still used in Berlin telegraph offices, the trial of the American sounder having just been instituted, and also that the lines are not quadruplexed.

THE CANADIAN ELECTRIC ASSOCIATION.

The present year has been noted for the lively interest which has been taken in the meetings of the various electrical professional bodies. The 1894 annual meetings of the American Institute of

Electrical Engineers, the National Electric Light Association and the Northwestern Electrical Association were the most successful in the history of those bodies, and the same seems to be true of the meeting at Montreal last week of the Canadian Electrical Association. The papers of Professors Rosebrugh, Mr. John Galt and Mr. E. A. Sperry are important contributions to professional literature, and the others on the programme were worthy of the occasion, if we except one or two of the perfunctory class, happily becoming more and more rare at such meetings. Mr. Keeley's method of distribution, as will be seen from the abstract we publish, is a close approach to the three-wire system; if, in fact, the plus or minus poles of the source of E. M. F. in this arangement were connected, we would have the three-wire system with a theoretical saving in copper of 62.5 per cent. instead of the 50 per cent. claimed by Mr. Keeley for his system. The design of fly-wheels is treated exhaustively in Mr. Galt's paper, and his thorough exposition of Prof. Sharp's new system of fly-wheel construction will be appreciated by those interested. With such authorities as Dr. John Hopkinson and Prof. Unwin advocating the use of the fly-wheel accumulators in central and power stations, the subject takes on an importance that cannot be neglected. Mr. Shaw's paper rendered a particularly good service by bringing up the subject of electrical medical nostrums, thus serving to counteract the influence of the favor which they met with in the electrical department of the World's Fair, and, more recently, in the columns of one of our contemporaries in the case of an electric hair brush. The paper by Prof. Rosebrugh is perhaps the most important on the programme, dealing, as it does, with an aspect of telephony to which, apparently, little attention has thus far been given. The social features of the meeting were not lesss successful than the professional ones, and our Canadian electrical friends are to be congratulated upon the success with which they are rivaling the older professional bodies of like character across the border.

INDUCTANCE AND CAPACITY.

The neutralization of the inductance of a line by means of a capacity, or vice versa, has been the subject of much mathematical writing, and of graphical demonstrations no more satisfying to those not accustomed to what might not inappropriately be called artificial methods of thought. What the average student of electrical phenomena wishes is first an idea of the mechanism of a phenomenon, as without this preliminary knowledge mathematical and graphical references to it will be likely to convey little information. For these the following may convey in a simple manner the idea of the respective action of a condenser and an inductance coil in series in an alternating circuit. Imagine the E. M. F. of the circuit to be rising; the result on the one hand will be that the condenser will be unbalanced and consequently will create a draught, so to speak, for enough current to again balance it; on the other hand, the increasing flow of current due to the increasing E. M. F. will introduce into the inductance coil lines of force opposing the flow of the current, or, in other words, lines of force generating a current in the opposite direction to the main current, and in the direction of the draught of the condenser. If now, the condenser and inductance coil are so proportioned to each other that these two effects are equal, the result will be that the flow of current in the circuit will follow the simple form of Ohm's law, the factors in the impedance formula for inductance and capacity cancelling each other. The relative effects of inductance and capacity may also be illustrated roughly by an analogue from steam engineering. In the exhaust pipe of a marine engine there is often a throttle valve, automatically actuated and used to prevent the engine from racing in a rough sea. In this case the throttle corresponds to an inductance and the steam condenser to a capacity. By opening the throttle wider (decreasing the inductance) or increasing the vacuum in the condenser (increasing the capacity) the flow of steam is facilitated; or, by increasing the vacuum and throttling at the same time, one effect will nullify the other, the increaased draught of the condenser being balanced by the increased throttling. In ocean cables the capacity interfering with the transmission of current, and in overhead transmission lines, the inductance increasing the drop, are distributed along the cable or line, and, therefore, to be theoretically neutralized the inductance in one case, or the capacity in the other, should also be distributed, so that the first illustration applies, not to the cable or line, considered as a whole, but to each infinitesimal portion of it.

ELECTRIC BRAKES.

The Institute paper of Mr. Sperry on electrical brakes has excited much interest, and deals with a subject which seems to be rapidly coming to the front. The electric brake possesses, undoubtedly, a balance of advantages, not only from the rapidity with which it may be placed in operation, but also from the greater power it can be made to develop. In the brake described the braking action involves three factors: First, the retarding torque of the car motor acting as a dynamo; second, the friction of the brake ring under the pressure due to magnetic attraction between the ring and the wheel; third, the torque due to the combination of the brake ring and wheel acting as a dynamo in the generation of eddy currents. The first effect is very small, and therefore does not cause the wear of gears which has rendered impracticable the use of street railway motors for braking by short-circuiting the armature; the second is more considerable, but the third effect is, singularly as it may seem, very large—in fact, the most important factor by far, if we accept Mr. Sperry's data, which we see, however, no reason to doubt. The arrangement, then, in principle, is an auxiliary braking dynamo of exceedingly simple construction, which has not the disadvantages incident to the use of the car motor for the same purpose. The manner in which the eddy currents are generated, and the determination of their paths, form the subject of an interesting problem, upon which the recent discussion in our columns on so-called unipolar dynamos may throw some light. Two explanations in regard to the former point suggest themselves. First, that the eddy currents are generated about the gap alone, because it is there only that the flux of magnetic force is varied; or, second, if we can assume a variation in pressure between the braking surfaces, the eddy currents generated in the gap are augmented by those resulting from this effect. Owing to the extremely small reluctance of the iron magnetic circuit, the introduction of an infinitesimal air gap would notably decrease the magnetic flux and thereby cause eddy currents, and it has been suggested that such an increase of reluctance may be caused by variation in pressure due to "chattering" or other variable action of the brake ring. Much of the data which Mr. Sperry gives in his paper on the subject has a value aside from the particular use there made of it, which is also true of his discussion of various points in regard to street railway braking. The controller described combines in itself the usual trolley controller and brake wheel, thus much simplifying the duties of the motorman. The ingenious and mechanically neat manner in which the various parts have been worked out excited much favorable comment at the Institute meeting, while the entire paper was received as one of timely importance and a worthy contribution to the *Transactions*.

Protection Against Lightning.

Thr London "Electrical Engineer" publishes a letter from Lord Kelvin with reference to the recent report of a lightning discharge at the Norfolk navy yard, by which two men were killed. He states it is proved by that accident that to secure against danger men working under a ship in dry dock there ought to be a thorough metallic connection, by wire rope or otherwise, between several points of the ship's iron, such as ringbolts, etc., and iron pipes leading to the water outside the dry dock. Similar precautions ought to be taken in respect to the frames of ships on the stocks in the course of building. An iron ship simply resting on wooden blocks, and without any connection by metal with the water of docks, or river, or sea in the neighborhood, is certainly dangerous, Lord Kelvin states, to persons standing on the ground and touching any part of the iron hull during a thunderstorm.

The annual meeting of the Canadian Electrical Association, which opened at Montreal on Wednesday, Sept. 19th, was one of the most successful gatherings of that body yet held, both in point of attendance and in the importance and interest of the papers presented.

President J. J. Wright, of Toronto, opened the proceedings by a few happy remarks of welcome and congratulation. Mr. C. H. Mortimer, secretary and treasurer of the association, presented his report for the year ending May 31, which showed that the number of active members was 99, and of associate members 38. The receipts during the year had exceeded the disbursements by $273. The report was adopted. Mr. J. J. York, on behalf of the Montreal branch of the Canadian Association of Stationary Engineers, tendered the visitors a hearty welcome, which was fittingly replied to by President Wright.

Mr. T. D. Lockwood, of Boston, who was present at the meeting, then had the distinction of being elected the first honorary member of the Association.

On reassembling after an adjournment for lunch the committees on legislation, statistics, by-laws and constitution were appointed, after which the first paper on the programme was read, which was that of Mr. W. B. Shaw's paper, and which dealt with "The Application of Electricity for Medical and Kindred Purposes from Light and Power Circuits." He first mentioned the uses to which the dentist puts the electric motor, stating that for a standard, upright pedal drill from one-twelfth to one-eighth horse power was required while a small lathe took about one-sixth horse power. Either two or three cells of accumulators were used or the current taken direct from a lighting or power circuit. He has never found the small alternating current motor to give as good results as a continuous current one. To the oculist he recommends a frosted lamp with a Ries regulating socket, and for the opthalmascope four 8-c. p. lamps. Nose and throat specialists, who simply use cautery apparatus, can best obtain the large current necessary from a small transformer, if an alternating current system is available. For the removal of superflous hair a simple equipment of 10 cells of the large size Sampson battery is sufficient. The regular practitioner wants (1) current for small examining lamps and for cauteries, which is usually obtained from a couple of cells of accumulators or a bichromate plunge battery. (2) Current for galvanic work, for removing fibrous tumors, etc., for which are required 48 or 50 cells of Leclanche battery, a milliampere meter and a double collector switch such as made by Gaiffe of Paris. (3) Faradic current for rheumatic and paralytic patients, which can be obtained from many of the Faradic portable batteries with induction coils, or sometimes the coil alone is used, connected to two or three cells of Leclanche battery from the Gaiffe outfit. (4) Mild continuous current for nervous diseases, obtained the same as for (2) except that in addition to the Gaiffe collector an adjustable rheostat, an interrupting button and a double arm switch for a pole-changer is required. A direct current of 110 volts, a rheostat and one or two cells of accumulator would replace all this cumbersome apparatus. For a physician's use in Montreal, where the available currents are a 52-volt alternating and a 250-volt direct, Mr. Shaw suggests the following arrangement: Let the 250-volt current run into the basement of the doctor's house and be connected up to a motor-generator of the one-h. p. type which gives 500 watts at the secondary end. The primary would take 250 volts; the secondary would reduce it to 52. This motor generator would be operated by means of a switch and rheostat placed upstairs in the doctor's operating room above the basement. The 52-volt secondary direct current wires would go to the lower terminals of a double pole, double throw switch. The house circuit for lights, etc., would come to the connecting knives or central contacts of the same switch, and the 52-volt alternating current should be run in and connected to the upper contacts of the same switch. The motor-generator could be left running during the daytime. The main switch would be down. There would be sufficient current for house lights, charging accumulators, running cauteries, motors, Faradic coils, galvanic current, etc., from it, and as a reserve he can throw up on to the alternating current, which can still continue to light his house lights, work his cautery, this time by means of small transformer.

In the discussion which followed Mr. Lockwood gave some amusing experiences of his with magnetic hair brushes. It was also maintained by others that the plan proposed by Mr. Smith was not perfectly safe where a high tension wire fell across an ordinary main. Mr. Smith claimed, however, that the battery system was also dangerous, for a wire was likely to corrode and the patient receive quite a severe shock.

"Electrolysis" was the subject of a paper by Mr. Jas. A. Baylis in which he presented a careful resumé of the whole subject, giving the experience of the New England Telephone and Telegraph Company at Boston, the results of the experiments of Prof. D. C. Jackson, and some of the various remedies which have been suggested and tried. The only sure cure for this trouble, he stated, was the adoption of some other system than the single trolley, such as a double trolley system, a storage battery or conduit system, or alternating currents, if a practical motor is found. With the single trolley, absolute protection is impossible, but to insure the greatest freedom from destructive action the track circuit must be of the lowest possible resistance, which means the best of bonding and frequent cross-connection of rails. The rail circuit should be reinforced by overhead returns connected to the rails at intervals. The negative pole of the dynamo should be grounded and the various systems of underground pipes connected to it by conductors of large carrying capacity.

From the discussion it appeared that gas companies as a rule had little to complain of. The destructive action is chiefly confined to the leading sheathing of telephone cables, etc. Mr. Lockwood stated that in Boston a very pronounced improvement followed the introduction of a copper return wire an inch in diameter. It was thought that in a small street railway system there was not much trouble from injury to pipes, but it was agreed that in large cities the best known methods for protection should be adopted.

Mr. L. M. Pinolet read a paper on "Alternating Motors," presenting an interesting resume of the subject. He stated in a simple manner the principle of multiphased motors and briefly traced their development, explaining the construction of a number of well-known types.

Considerable discussion followed the reading of the paper, there being a wide difference of opinion as to whether mutiphased motors were yet in commercial use.

After the reading of Mr. Pinolet's paper the committee appointed to consider the membership fees, reported, recommending a reduction of the active membership fee from $5 to $3 per annum in the belief that an incresae of membership would result. The report was adopted and the convention adjourned for the day.

In the evening the members, through the courtesy of Mr. Paige, managing director of the Packard Electric Company, attended a performance of the "'Black Crook" at the Queen Theatre.

On Thursday morning at 9.30 the members of the association met at the Mechanical Engineering Building of McGill University and under the guidance of Prof. Carus-Wilson inspected the dynamo room and electrical laboratory and witnessed a practical test on a transformer for the measurement of the power of an alternating current. The Convention assembled at 11 A. M., and Mr. E. Carl Breithaupt then read a paper on "Municipal Electric Lighting," presenting the various arguments in favor of private ownership and illustrated by examples drawn principally from Mr. M. J. Francisco's collection of data. The conclusion is that while in towns which are not large enough to make the business remunerative, the installation of a plant by the corporation may be justified because street lighting is a public necessity, where private plants already exist that are able and willing to supply the municipality at a fair price, the outlay cannot be regarded otherwise than as an unnecessary expenditure and a waste of public money.

The paper was discussed at some length by M. J. Francisco and others. Mr. Francisco considered it impossible for municipalities

to satisfactorily run their own lighting plant on account of the lack of honesty and integrity on the part of those in control of the public business.

On reassembling after an adjournment for luncheon Mr. D. H. Keeley described at length "A Method of Distribution with Equalization of Potential Difference," which, he claims, admits of a saving of 50 per cent. in copper if used in the two-wire system. Two sources of E. M. F. are required, and one loop of the exterior circuit connects the two + poles, and another loop the two minus poles. That is, a line starts from one + pole, passes through the distributing area and returns to the + pole of the other source of E. M. F., and the — parallel line (lamps being connected between the + and — parallel lines) is similarly connected to the two — poles.

This paper gave rise to a spirited discussion which the president was compelled to close for lack of time.

Mr. Higman, of Ottawa, made a few remarks on the electric light inspection act, touching on the clauses dealing with the insulation of consumers' wires, the limitation of variation of the voltage, the illumination of the lamps and the inspection of meters.

In a "Note on Possible Reduction of Station Plant on Small Electric Railways by Multiple Series Control of Motors." Mr. John Langton gives the advantages of the multiple series method for small roads. In starting, by throwing the motors in series the same traction is obtained with half the current from the line used with the motors in parallel. In starting, and getting up to speed in the same length of time, the power consumption is about two-thirds that of the parallel method. The same results can be obtained by using the multiple series control for going up grades, if we are content with a reduced speed. The total power consumption is the same, but the maximum demand on the power station from any one car is reduced nearly one-half. On small roads this means an actual reduction in the size of the station plant. On large roads the saving would not be so material, as with any system of control the principle of averages can be relied upon to a great extent to reduce the station capacity, and furthermore speed is there generally an important consideration.

At the close of the session about 60 members availed themselves of the invitation of the Montreal Park and Island Railway Company for an excursion to Back River, where they were conveyed on two special cars. The annual dinner of the association was held at Polaquin's Hotel. President J. J. Wright presided, and after the toast of "The Queen" had been honored, that of "Sister Societies" was proposed and reasponded to on behalf of the National Electric Light Association by President M. J. Francisco, who expressed the hope that the time was not far distant when the American and Canadian associations would be one. He trusted that the matter would be considered by the Canadian Association and extended to its members a hearty invitation to attend the next convention of the National Electric Light Association. Mr. T. D. Lockwood also made a happy response to the toast, speaking of the growth of electrical societies during the last decade, and stating that there had never been a time when the societies of the United States and Canada had been on so firm and satisfactory a basis.

Mr. H. Marple responded to "The Montreal Park and Island Railway Company," and Mr. A. M. Wickens to "The Stationary Engineers." After a few remarks by L. B. McFarlane the meeting adjourned to an upper hall and spent an hour or two in song and story-telling.

Friday morning was devoted to the reading of the remaining papers on the programme.

In a paper on "The Possibility of Securing Better Regulation at Central and Power Stations by Means of Fly Wheel Accumulators of Improved Construction." Mr. John Galt advocates the use of fly wheels in order to provide for the peak of load curves and thus reduce the investment in machinery and also secure better regulation. The theory of the fly wheel is gone into at length and its application to cases in electrical working illustrated by examples. A new type of fly wheel invented by Prof. Sharp, of England, is discussed very fully and its mathematical theory gone into in detail. The Sharp fly wheel is constructed on the same principle as bicycle wheels, the spokes being tangential, not radial, to the hub, which has helical grooves; one rod makes two spokes, the loop fitting into the groove. In a wheel illustrated there are 24 spokes, or 12 loops and a helix in the hub corresponding to 3 threads of a screw on each side, or 6 threads in all. The ends of the spokes are secured to the rim in one plane, being held by bolts.

Mr. F. J. F. Schwartz read a paper on "Cable Construction and Cable Faults," in which he sketched the development in telephone cables, described the various forms of cables that have been and now are used, the method of suspension of aerial cables and of the laying of the underground lines, etc. A number of interesting exhibits of pieces of cables were shown, illustrating the many forms of injury to which the cable lead is subjected; in one case a slight cut had developed into a large opening, in another a wire resting against the lead covering had sawed into the cable; while in others contact with a trolley wire had produced serious burns.

The paper by Mr. T. R. Rosebrugh on "Duplex Telephony," will be found in abstract elsewhere in this issue.

THE ATTENDANCE.

Among those present were President Francisco and Secretary Porter, of the National Electric Light Association, of the United States; T. D. Lockwood, Boston; W. B. MacLaughlin, of THE ELECTRICAL WORLD, New York; Jas. J. Wright, Toronto; K. J. Dunston, Toronto; John Carroll, Montreal; C. H. Mortimer, Toronto; W. B. Shaw, Montreal; H. O. Frost, Peterboro, Ont.; D. A. Star, Montreal; George Black, Hamilton, Ont.; A. S. Smith, Toronto; L. B. McFarlane, Montreal; T. B. Rosebrugh, Toronto; E. C. Breithaupt, Berlin, Ont.; John Yule, Guelph, Ont.; Thos. Ahearn, Ottawa; Wm. Bourne, Toronto, H. A. Brown, Montreal; Robt. Dickinson, Toronto; John Langton, Toronto; F. Thomson, Montreal; Jas. Burnett, Montreal; W. A. Scott, Napanee; Jas. Green, Montreal; F. J. Schwartz, Montreal; J. A. Baylis, Toronto; L. W. Pinolet, Montreal; G. H. Keeley, Ottawa; Prof. C. A. Carus-Wilson, Montreal; R. J. Moles, Arnprior; C. E. Arnoldi, Ottawa W. G. Slach, Montreal; Geo. Taylor, Peterboro; Robert Jones, Montreal; O. H. Hegman, Ottawa; J. T. Tower, Toronto; C. R. Brown, Ottawa; J. Kamerer, Toronto; D. C. Dewar, Ottawa; W. H. Wiggins, Montreal; C. A. Bissett, St. Johns, Que.; Charles F. Medbury, Ottawa; Charles Paige, Montreal; M. White-Fraser, Toronto; Wm. Mackay, Renfrew; A. A. Wright, Renfrew; A. Marples, Montreal; K. J. Daneta, Toronto; J. Black, Hamilton; J. J. Carroll, Montreal; A. C. McKens, Montreal; A. B. Smith, Toronto, and A. Langton, Toronto.

Annual Meeting of the New York Street Railway Association.

The twelfth annual meeting of the Street Railway Association of the State of New York was held at Syracuse, N. Y., on Tuesday, Sept. 18th, 1894. President D. B. Hasbrouck presided and delivered the opening address. He congratulated the Association upon the progress made during the past year, notwithstanding the pressure of the times, and made some happy remarks about the place of meeting, closing with a tribute to the memory of the late William Richardson.

The report of the Executive Committee, which was then presented, showed that the membership now consists of 30 companies, the highest number ever reached. It called attention to the special reports presented at this meeting and extended a greeting to the Michigan Street Railway Association, recently organized. It also announced that in order to enhance the value of the work of the Association Mr. C. J. Bissell, of Rochester, N. Y., had been secured as special counsel to attend to street railway interests during the annual sessions of the Legislature. The report closed with obituary notices of William Richardson, H. W. Slocum and H. F. Drayton.

According to the report of the secretary, which was next in order, the receipts for the past year were $5,860.09, while the expenditures were $5,381.20, leaving a balance of $478.89.

Mr. J. B. Craven then read an interesting paper on "Economy in Electric Power," an abstract of which will be found elsewhere in this issue. Some discussion followed which was participated in by Messrs. Cole, Craven, Seeley and Issertel. The paper of Mr. Geo. E McNulty on "Recent Improvements in Cable Traction" was next read. This embodied a large amount of interesting information in regard to improvements in cable traction embodied in the Broadway cable line, New York City. A voluntary paper was then presented by Mr. Allen R. Foote, of Washington, D. C., in which the author treated in a very interesting manner the subject of "Taxation."

The election of officers was next in order and the nominating committee made the following report: President, G. Tracy Rogers, Binghamton; first vice-president, John H. Moffitt, Syracuse; second vice-president, William W. Cole, Elmira; secretary and treasurer, William J. Richardson, Brooklyn; executive committee, D. B. Hasbrouck, New York; John N. Beckley, Rochester; Daniel F. Lewis, Brooklyn. Albany was selected for the next place of meeting. The report was approved and the meeting then adjourned.

Exhibits were made by the following companies: H. W. Johns

Manufacturing Company, Consolidated Car Heating Company, Taylor Electric Truck Company, Cutter Electrical Manufacturing Company, Davis Automatic Car Shade Company, and the Peckham Motor, Truck and Wheel Company.

In the afternoon the visitors were driven around the city and shown the various points of interest. An inspection was made of the new track being laid by the Syracuse Street Railway Company. In the evening a complimentary banquet was tendered to all in attendance and was a very pleasant affair.

Gas and Electricity.

A rule given by Mr. Preece for comparing the costs of gas and electricity for lighting, is as follows: "Gas at three shillings (about 75 cents) per thousand equals electricity at sixpence (about 12 cents) per unit (kilowatt-hour)" or in other words, that the factor is about six.

Duplex Telephony.*

BY T. R. ROSEBRUGH.

After explaining the difference between a telegraph and a telephone circuit and giving the reasons why a single metallic conductor with earth connection at each end will transmit simultaneously four messages when used on a telegraph circuit, yet will only suffice for a single conversation as a telephone line, the author states that since two wires are necessary for the proper transmission of one message by telephone it might hastily be asumed that this is a constant ratio; that is, that the conductor, must always be twice as many as the number of messages that are to be transmitted simultaneously. The fact is, that it is the difference and not the ratio that is constant. There is no doubt, for example, that if it were necessary, ten messages could be transmitted simultaneously by eleven conductors without interference, although in that case it is exceedingly doubtful whether the complexity of the system would not preclude its use.

The most natural way of proceeding to increase the transmitting capacity of telephone conductors is to regard the already existing two-wire metallic circuits as the units out of which to construct metallic circuits of a higher order, which may be termed derived circuits.

It is necessary then that two points be obtained on a two-wire metallic circuit, satisfying the condition, firstly, that no difference

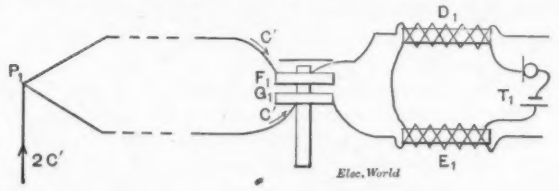


FIG. 1.

of potential be produced between them by the action of the transmitters already in that circuit, and secondly, that no effect be produced in the receivers of the circuit by the entrance and exit of current at these two points. The first condition may be satisfied in two ways according to the arrangement of the instruments already in circuit. If intermediate transmitting instruments are to be in series they must be divided into two similar parts, one in each line as in Fig. 1 are D and E, two secondary coils of transmitter T_1, arranged so as to contribute at each instant electromotive forces equal and in the same sense with regard to the metallic circuit, and therefore in opposite directions with regard to the line.

If the two sides of the metallic circuit have the same resistance it will be seen that no difference of potential can be produced between the points where the two lines unite, as in Fig. 1 at P_1, and the corresponding point at the other end of the line. If, however, the transmitting instruments are only at the terminals or are bridged across between the two sides at intermediate stations, as in Fig. 2, no such modification in their structure is necessary, for their action cannot produce any difference of potential bewteen points which are at the middle of any bridges between the lines.

It is not true, as might at first be supposed, that every bridge has a middle point, for such a point must divide both the resistance of the bridge, and its inductance, if there be any, into two equal part, and there will not in every case be such a point. In the case of a secondary of a repeating coil it will be necessary also that the two parts have equal mutual inductance with regard to the primary

* Abstract of a paper read before the Canadian Electrical Association at Montreal, Sept. 21, 1894.

before the point between the two coils satisfies the condition of having the mean potential at every instant.

Since in any case the currents introduced on the lines of a two-wire metallic circuit must divide equally and flow parallel to one another in the same direction, we find the condition that the receiving instruments of the original metallic circuit should not be disturbed by such currents to be, either that the currents should not flow through the coils at all—which may be attained by bridging them between opposite points on the two lines; or, if the introduced current on one line flows through a coil of the receiving instrument, then that on the other line must flow through a coil in the opposite direction, which is just capable of neutralizing the magnetic effect of the first. As for instance in Fig. 1, the introduced current $2c'$ entering at P_1, divides into two parts c1, which circulate in opposite directions through the coils F_1 and G_1 of the receiver, and produce no effect, and similarly also in the coils F_2 and G_2 on the same line. Supposing the bridge method selected as being applicable more generally, let us look at the different ways in which it may be carried out. In Fig. 2, L_1 and L_2 are two lines which are supposed to be already in use as a metallic circuit, T_1 and S_1 being the transmitter and receiver at one end, and T_2 and S_2 at

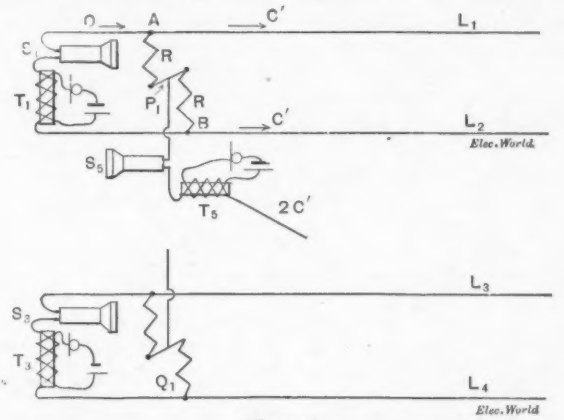


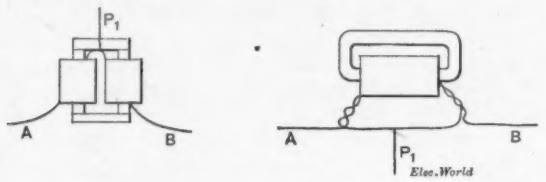
FIG. 2.

the other. L_3 and L_4 are similarly two lines of another metallic circuit. Between the points A and B are connected in series two equal non-inductive resistances R. At their common point P_1, a wire connects through telephonic apparatus T_5 and S_5 with P_2, a similar wire on the same metallic circuit, including also at the second end the telephonic apparatus T_6 and S_6; or it may connect with Q_1, which is a similar connection on the second metallic circuit, and similarly P_2 with Q_2, both connections including telephonic apparatus. Each of these bridges has then a resistance $2R$, but owing to the line resistance it would be generally incorrect to say that they are equivalent to a single shunt of resistance R. The current on the derived circuit passes through the coils of each pair of resistances in multiple, and each is therefore equivalent to $\frac{1}{2}R$. It is to be noted that currents arriving at A and B from P_1, on the derived circuit, do not divide at these points as might be supposed, but that portion of the circuit at the end between A and B, including T_1 and S_1, is left entirely dead, since, due to such currents, there is no difference of potential between A and B. The same thing applies also to T_2 and S_2, and to any other telephonic apparatus of this circuit bridged across between L_1 and L_2, which is not provided with an exit at its middle point.

As a first improvement on this construction it may be suggested that a self-inductive resistance would be better than a purely ohmic resistance, if not connected exactly at the ends of the line, for it would partly compensate the effect of electrostatic capacity between the wires.

The next step in advance is to put the two coils R together on the same core as in a telegraph relay, Fig. 3, so that while the leakage current passing from A to B through the two coils in the same direction around the core, reinforces the magnetism of the core and experiences consequently a high impedance, that from the derived circuit which enters at P, the middle point, and divides there, passing in opposite directions around the core in the two coils, affects the magnetic circuit comparatively little, and has therefore low impedance. In the case of an ordinary box relay of 150 ohms we would have in series from A to B a resistance of 150 ohms, and an inductance of 4.8 henrys, while from P_1 to A and B in parallel we have 37½ ohms and .49 henry, or to the note "middle C" an impedance of about 7,730 ohms to currents leaking through its coils in series, and 790 to the derived currents dividing from the middle

point outwards, making a total impedance of 3,160 ohms in addition to the ohmic resistance of the derived circuit. Better results than this could be obtained by superimposing the windings instead of having them on separate limbs of the magnetic circuit. The best possible results, however, will be obtained when the derived current forking at P_1 to A and B traverses practically identical courses in opposite directions around the magnetic core, and has therefore a non-inductive path, while the leakage current from A to B passes over this course twice in the same direction, experiencing the maximum impedance. This may be accomplished most exactly by twisting the wires together and winding the double conductor on the coil. A coil made in this way, Fig. 4, measured 480 ohms and 4.6 henrys to the leakage current, or an impedance of about 7,400 ohms to the note "middle C," while to the derived current entering at its middle point it was practically a non-inductive resistance of 120 ohms. In good modern construction it is necessary on circuits of moderate length to transpose the wires on the poles, in order to expose them equally to outside disturbing influences. In addition to this transposition, to get the best results it is often desirable to transpose the circuits among themselves; this transposition of the metallic circuits is more necessary when derived circuits are formed



FIGS. 3 AND 4.

from them, for in that case transposition on the poles is as important as it is for single conductors to which they are then equivalent. For this reason the derived circuit should not be applied to a pair of circuits differing materially in length.

The underground cable system connecting stations in the same city affords an excellent opportunity for the application of the above principles, for a large number of metallic circuits between the same two points are in continual demand and are quite expensive. A redistribution of the positions of the wires in the cable being made at every manhole, the transposition must be quite thorough.

Coils such as are indicated in Fig. 4 have been in use in Toronto for some time on the cable between the main office and the Yorkville station; they afford an extra speaking circuit for each pair to which they are applied, in which as well as in the two original circuits, speech is perfectly transmitted. The same thing is true of a pair of metallic circuits between Toronto and Hamilton, when the circuits are free from long extensions.

It appears quite probable that on very long lines the decreased conductor resistance and self-induction of the derived circuit as compared with the originals would fully counterbalance the increased electrostatic capacity and give, for example, between New York and Chicago, three speaking circuits for every four conductors, instead of two, the transmission being unimpaired in any of the circuits.

Economy of Power-House Operation.*

BY J. B. CRAVEN.

Mr. Craven believes that it is in the boiler-room where in most cases the greatest waste will be found. It has been said that the waste due to improper firing is often of greater consequence than any other loss which is produced in the operating of a steam plant. There are two causes for this: First, poor construction of the boiler. Second, poor firing and lack of care of the boilers. Many think that any man can fire a boiler, and whilst looking with awe and wonder at the engine and generator, forget that all the power comes from the coal pile and pay little attention as to the economy in transmitting that power from the coal to the engine. No greater mistake is made than to place the care of boilers in incompetent hands, for they require the highest degree of care, conscientiousness and constant attention.

The fireman must be ever on the watch to see that the water is kept at the proper level, to keep an even steam pressure, and to show by his steam, coal and water records that he is getting just as good cards as the engineer can show by the manipulation of the steam he uses in his engine. He must see that the fires are spread evenly over the grates and are of an even thickness, that the proper amount of air is admitted into the furnace to obtain good combustion. When it is realized how easily from 1 to 20 per cent. of coal can be shovelled into the furnace and up the chimney without generating any more power, the importance of having something more than mere machines shovelling coal into a furnace becomes evident. Another point of importance is to see that the boilers are kept clean and free from scale, which is simply the result of improper attention. Boiler scale not only causes loss of heat, but by leaving the iron exposed to the effects of the heat without the proper circulation of water back of it, causes rapid deterioration, and in some cases an explosion. Mr. Craven states that he has used quite a number of boiler compounds for the prevention of scale, but has found the best to be plain coal oil. This has been used in Buffalo for the past two years with success, putting about one pint a day into each boiler and letting it enter with the feed water by means of a sight feed lubricator. No one remedy, however, will fill all cases, and each must be the subject of some experiment.

As to feed-water heaters, if engines are running non-condensing, the question is very easily settled; as, however, the majority of steam plants are run condensing, other factors are brought in. In the power-house of the Buffalo Railway Company one-seventh of the engine capacity is run high pressure. In this way, taking the feed water from the hot well, at an initial temperature of 110 degrees, and passing it through two heaters in the exhaust of the high pressure system, a final temperature of 19 degrees is attained before the water enters the boilers. It is claimed by some that this method of taking water from the hot well is not right on account of the oil to be found in this water. But so small a portion of the hot well water is used, that the amount of oil in it is small, and by this method secondary heaters are done away with in the exhaust between the engine and the condenser, and not only save in the first cost, but slightly better results are obtained. However, one thing is important, whatever means are used to heat the feed water, it should be done, for not only will there be a great saving in fuel, but the straining of the boilers due to putting cold water in, will be done away with.

Passing from the boiler room to the engines and generators, it is evident to all that where the space is valuable the direct connected unit has the advantage of taking up less room. They can be thrown in and out of service with as much rapidity as the belt driven machine; there is a saving of from 1½ to 3 per cent. due to the slipping of belts, very little in itself, but when figured up at the end of the year in a plant of any size will amount to considerable. Added to this there is the saving in labor and the decreased expense due to wear and tear, as this item is less in slow speed than high speed machinery. For the above reasons Mr. Craven draws the conclusion that direct connected units are more economical than high speed ones. Regarding the size of units used, it depends entirely on the output of the plant, but they should be as large as possible, yet not so large that the breaking down of one would cripple the traffic. However, in plants that have not these latest types of machines, great savings may be made in the operating of the engines. In many cases after the constructing engineer has left, engines are oftimes supposed to look after themselves, those in charge simply supplying them with steam and oil. What has been said in reference to the man in charge of the boiler-room applies with equal force here. A thoroughly competent man in charge will be a paying investment. Intelligence and experience are the best safeguards and the real insurance against accidents. Fifty dollars a month more to a capable engineer will probably be repaid a hundred times by the care taken and the high state of efficiency in which the machinery is kept. In such a state an engine is a reliable piece of mechanism. If neglected it is liable to fail at any time, causing delays and worries, and not only adding to the expense in the cost of repairs, but a loss in the receipts outside.

A capable engineer will see that his engines are indicated at least once a month, to see that the valves are properly set and so keep the steam consumption down to a minimum. All pounding, knocking, and leaks should be followed up and remedied at once, and the engines kept in such a state as at all times to be ready to perform the severest service exacted from them. Always keep the load as near the normal capacity of the engines as possible, as engines at that point are most economical; besides, you will have fewer machines in service and thus save in the oil supply. Quite a saving may be made in oil, and an instance is cited of one engineer who used $640 worth of oil more in six months than another engineer in the same time, and the engine capacity was increased during the time the last man was in charge. The lowest priced oil is not

*Abstract of a paper read at the twelfth annual meeting of the New York State Association, September 18, 1894.

always the cheapest; some oils will go much further than others, and the question of what to use should be settled only by careful examination. After being used once it can be filtered and used again on the lighter parts of the machinery. If rags are used for wiping instead of waste they can be washed and used again, and the grease and oil extracted will be found useful in some part of the system By washing the rags 80 per cent. can be saved over what the cost would be if only used once and thrown away. The generator should be kept dry and thoroughly clean, and the commutator kept as smooth as possible. The principal trouble will be found in the sparking of the brushes and the heating of the armature and the field coils.

Electrodynamic Machinery—IX.

EDWIN J. HOUSTON AND A. E. KENNELLY.

43. Besides the case of the anchor ring, represented in Fig. 44, the magnetic circuit of which being entirely confined to the interior of the coil, permits its reluctance to be readily calculated and the flux to be arrived at, another case, almost as simple, is found in a long straight helix of length l cms., uniformly wrapped with n, turns per cm. or $N = l\,n$, turns in all. Such a helix, when excited by a current of I, amperes, develops a M.M.F. of $n\,I$ ampere turns, or $1.257\,n\,I$ gilberts per centimetre, or $1.257\,N\,I$ gilberts for the total M.M.F.

The magnetic circuit of such a solenoid is roughly represented in Fig. 21. An inspection of this figure will show that flux passes through the interior of the helix in parallel streams, until it reaches a comparatively short distance from the ends, when it begins to sensibly diverge, and, emerging into the surrounding space, is diffused through widely divergent paths. That is to say the magnetic circuit is characterized by two distinct regions; namely, that within the coil, where the flux is uniform, and, except near the ends of a maximum intensity, and that outside and beyond the ends of the coil, where the flux is divergent and greatly weakened in intensity.

44. In the case of a long, straight, uniformly wrapped helix, the reluctance of the circuit may be considered as consisting of two distinct portions; namely, a straight portion occupying the interior of the coil and lying practically between the ends, and a curved or diffused portion exterior to the coil. The reluctance of the first or interior portion will be practically $\frac{l}{a}$ oersteds, where a is the cross sectional area of the coil in cms. and l, the length of the coil in cms., or more accurately the reduced length of the non-divergent flux. It will be seen, therefore, that the interior of the coil behaves like a straight wire carrying electric flux, since it practically confines the flux to its interior, and, that this particular portion of the magnetic circuit is similar to the case of the anchor ring above referred to, where the magnetic flux is confined to the interior of the ring.

Since the external circuit possesses diffusion, its reluctance cannot be so simply expressed. Its value, however, may obviously be dealt with as follows: although the mean length of the flux paths outside the coil is greater than in the interior portion, yet the area of cross section of the circuit is enormously extended. It would appear, therefore, that in the case of an indefinitely long straight coil, the external reluctance becomes negligibly small compared with the internal reluctance, and may be left out of consideration. In such a case, therefore, the flux established

$$\Phi = \frac{1.257\,l\,n\,I}{\frac{l}{a}} = 1.257\,n\,I\,a \text{ webers},$$

and since this flux passes through a cross sectional area of a square centimeters, within the coil, the interior intensity will be

$$\mathfrak{B} = \frac{1.257\,n\,I\,a}{a} = 1.257\,n\,I \text{ gausses}.$$

Strictly speaking, therefore, this is the intensity of flux within an indefinitely long straight helix and is approximately the intensity within helices which have lengths more than 20 times their diameter.

45. We have now discussed two cases of non-ferric circuits whose reluctance is readily calculated; namely, a closed circular coil and a long straight helix.

In all other cases, the reluctance of the branching and divergent paths is much more difficult to compute, although the fundamental relations remain unchanged.

When the magnetic circuit is non-ferric, although the reluctivity of the circuit always equals unity, yet, owing to the difficulty of determining the exact paths followed by the divergent flux, the reluctance is difficult to determine.

Most practical magnetic circuits, however, are composed either entirely, or mainly, of iron. At first sight the introduction of iron into the circuit would appear to make the reluctance more difficult to determine, because the reluctivity of iron not only varies greatly with different specimens, but also with its hardness, softness, annealing, or chemical composition. Moreover, the apparent reluctivity of iron varies markedly with the density of the flux passing through it. Iron, when magnetically saturated, possesses a reluctivity equal to that of air; while, as we have seen, at low intensities the reluctivity is much smaller, and may be several thousand times smaller.

Since, however, ferric circuits, as ordinarily employed, practically confine their flux paths to the substance of the iron, and, since the reluctance of the iron is so much less than the reluctance of the alternative air path outside, the air flux may usually be neglected. Even where, owing to the reluctance of the air gaps in the circuit, such as in the case of dynamos and motors, a considerable amount of leakage or diffusion may take place, yet it is preferable to regard this leakage as a deviation from the iron circuit, which may be separately treated and taken into account, and that the flux passes principally through the iron. For these reasons ferric or aero-ferric circuits, at least in their practical treatment, are simpler to determine and compute than non-ferric circuits, since, although their reluctivity is variable, yet the geometrical outlines of the flux paths can be regarded as limited, and the reluctance of these paths readily can be determined.

46. Magnetizing force may be defined as the space rate at which the magnetic potential descends in a magnetic circuit. Since the total fall of potential is equal to the M.M.F. in the circuit, just as the total "drop" in a voltaic circuit is equal to its E.M.F. Consequently the line integral of magnetizing force in a magnetic circuit must be equal to the M.M.F in that circuit. In other words, if we multiply the rate of descent in potential by the distance through which that rate extends, and sum all such stages, we arrive at the total magnetic potential descent. For instance, in Fig. 44 the total

FIG. 45. IRON RING PROVIDED WITH AIR-GAP, AND WOUND WITH WIRE.

difference of magnetic potential is 1005.6 gilberts, which, by symmetry, is uniformly distributed round the entire circuit. Since the mean length of this circuit is 60 cms. the rate of fall of potential is $\frac{1,005.6}{60} = 16.76$ gilberts per centimetre all round the ring, and this is therefore the magnetizing force. This magnetizing force is usually represented by the symbol $\mathfrak{H}$, and when no iron or magnetic metal is included in the circuit, is identical with the flux density $\mathfrak{B}$, so that $\mathfrak{H}$ is expressed in gausses. The term magnetizing force was adopted from the less recent conception of magnetic poles; for if a pole of unit strength could be introduced into a flux of intensity gausses, the mechanical *force* exerted upon the pole would be $\mathfrak{H}$ dynes, directed along the flux-paths. In any magnetic circuit, if we divide the M.M.F. in gilberts by the length of a flux path we obtain the average value of the magnetizing force (or flux density in the absence of iron). Thus, in Fig 21, if the long helix there represented has a M.M.F. of 5000 gilberts, and a particular flux path has a length of 500 cms, the mean flux density, if there is no iron in the circuit, and the mean prime flux density or magnetizing flux if there is iron, will be $\frac{5,000}{500} = 10$ gausses. The intensity outside the coil will usually be considerably less than this, and the intensity inside the coil considerably greater.

(To be continued).

Electricity in Berlin.

For the assistance of the members of the Verein Deutscher Ingenieure in their visits of inspection about Berlin during the recent meeting of the Verein in that city, a volume of 300 pages had been prepared containing a series of articles by well-known specialists, giving clear and practical descriptions of the most interesting engineering features of the capital city. From this book the following is abstracted, relating to electric lighting, the telephone and telegraph:

It is shown that from 1885 to the present time the current output for house lighting has increased from 635,800 to 94,000,000 normal lamp hours, and for street lighting from 50,890 to 400,000 normal lamp hours, while the number of lamps connected has grown from 4,900 to 203,050. From 1889 to the present time the energy consumed by small motors for industrial purposes has risen from 12,956 to 575,000 kilowatt-hours.

On a yearly average one kg of coal burned in this plant gave regularly 560 watts of current at the point of consumption, a result which has probably not been reached by any other central station in the world.

The Berlin telephone system was opened on the 1st of April, 1881, with 33 subscribers. At the end of 1893, the number of subscribers amounted to 23,420, divided among six large exchanges. On account of this great number, there was made last year a change from overhead conductors to a mixed system of running the wires. Starting from the exchanges, the conductors are run underground for a distance of about one km and thence carried overhead to the individual subscribers. Besides this, a large number of connecting wires between the different exchanges are laid entirely underground. The conduit network which was put down at the time, was calculated for an increase to 40,000 subscribers; it was thought then that the requirements had been greatly exceeded, but the day is not far distant, when at least part of the system will have to be enlarged. Bronze wires, 1.5 mm in diameter, are principally used for overhead conductors; the wires are carried exclusively on supports of double flat-iron, attached to stands made of iron tubes with sides 5 mm. thick, which are fastened and anchored to the house ridges. The distance between the poles is usually 150 m; as as protection against lightning, every rod is connected with four galvanized iron wires, each 4 mm in diameter, which lead to a gas pipe, of 10 cm. internal diameter, which serves as an earth plate. In order to prevent the conductors from vibrating, there are used rubber cylinders, 15 mm thick and 10 to 15 cm long, which are split open and surrounded for their entire length with strips of tin 0.5 mm thick, fastened with binding wire.

The telephone cables used are 32 mm in diameter, contain 28 conductors and weigh 4 kg per meter. They are laid in round, cast iron jointed pipes, asphalted inside and out, 200 to 400 mm in diameter and about 80 cm beneath the surface of the street.

On the 1st of January, 1894, the length of the overhead wires amounted to 40,980 km, and that of the undergrown cables to 603 km, with 17,469 km of conductors.

All the long distance interurban traffic is conducted from the main office on Franzosische Strasse. From this point 20 lines lead in different directions to Hamburg, Frankfort A-M, Liepzig, Breslan, Königsberg and so on. The longest line at present is the one to Königsberg, 676 km. Two somewhat longer ones are being built, Berlin to Vienna and Berlin to Munich.

The main telegraph office of Berlin is on Franzosische Strasse, where 345 lines end, 52 of which serve for direct foreign traffic, and the rest for domestic business. There are 133 telegraph offices in Berlin. Current is furnished by accumulators, which are charged partly by dynamos and partly by primary cells, 2,000 of the latter being now used for this purpose, instead of 13,000 as formerly. The number of incoming and outgoing dispatches at Berlin amounts in one year to thirteen million, which are taken care of by 122 sets of Hughes printing telegraph apparatus and 247 Morse recorders. Trials have lately been begun with sounders of American and English forms. The Hughes apparatus has a capacity of about 1,200 words and the Morse color recorder about 400 words over one wire, the line in either case being used for single transmission.

Experience as a Teacher.

In an editorial the London "Electrical Review," closes with the following remarks: "In the matter of publishing to the world their own mistakes our own engineers may take a lesson from Americans, whose society proceedings often contain frank admissions of the mistakes made by the speakers and the results thereof, and means taken to repair damages."

The Earth as an Electrical Conductor—II.

BY JOHN HENRY HOLT.

From the well plates, as also from the earth plates, were run short copper wires to a switch, by which arrangement, at the option of the experimenter, the ground plates could be used alone, the wells alone, or both in parallel or series.

The portion between the terminal stations is divided into five intermediate ones, each 500 feet from the other. Commencing on the right in the figure, they will be designated hereafter as station (1), station (2), and so on across the line. At these stations ground connection was made by driving down, flush with the surface of the earth, wrought iron rods, six feet long and two and a half inches square, to each of which was soldered a copper wire, which could be readily connected to the overhead line wire.

The figure represents a cross section of the earth included between the terminal stations and taken in a direction parallel to that of the line, though only to a limited depth. The portion under investigation, as well as all of the surrounding country, was once the scene of very active geological agencies, mainly aqueous. Very great erosive effects on the one hand, and the disposition of "drift" on the other, are evidences of the presence of such agencies.

Holes were dug at each station to a sufficent depth to ascertain the character of the soil penetrated by the ground connection at that station, and also by the aid of four wells along the line it was possible to locate pretty well the strata.

The depth to which the cross section is taken includes two geological formations. The top stratum seen at stations (1), (2), (4) and at (B), and covering all of the hill tops, consists of a drift deposit. It is variable in thickness, at (1) being from twelve to fifteen feet thick, and growing thinner, of course, as the hill sides are approached. At (B), however, it is not more than three feet deep. Stations (1), (2) and (4) lie entirely within this stratum—that is, the ground rods do not extend into the stratum directly underlying it. In this drift formation is found a great many rocks—water-worn pebbles—scattered throughout the highly silicious earth which composes it. In addition to the quartz pebbles, other foreign substances, as rutile and tourmaline, abound between stations (1) and (3) especially. The hill top at (4) is covered with iron geodes, they too being foreign, having probably been washed up with the rest. From the very nature of the case, this stratum is an exceedingly porous one.

The stratum directly underlying the drift is one of the older formations, probably Laurentian. That portion of it which surrounds the plates at (A) and (B), and also at the ground rod at (5), upon analysis was found to be a very red clay soil, containing a great deal of iron.

The fact that iron geodes (foreign) are numerous along the hill side between stations (3) and (4) does not destroy the assertion that the soil there contains a great deal of iron itself, but there may be seen the formations of the red clay soil in spots from the iron in situ.

The valley in which station (3) is located was once gorged much deeper than atpres ent, having been filled to a great extent by an alluvial deposit—washings from the adjacent hill slopes.

As is indicated in the figure, a small stream flows at right angles to the line in the valley on the left of (3). The stream is about three feet broad, and very shallow at the point of intersection with the line.

(1) To find the resistance between the two terminal stations (a) with earth plates used as grounds, we shall take first the case in which the current is obtained from a dynamo. The method adopted for finding resistance was simply to pass the dynamo current through the line, with a volt and ammeter in circuit, and, from their respective readings calculate the resistance by Ohm's law. A Weston voltmeter and Thomson's graded ammeter were used.

The current was switched on at 60 volts, and increased 10 for each subsequent reading, from 60 to 150 volts. At 60 volts and a current of .54 of an ampere, the resistance was found to be 111 ohms; for 70 volts, it was 112, and at 90 volts was 113 ohms; but at 110 volts and a current of 1.15 amperes, we find the resistance to be again 112 ohms. Carrying the voltage to its maximum, 150, and the current to 1.36 amperes, the resistance rises to 115. By taking the average of the ten readings, the resistance by this method is found to be 111.1 ohms. The variation in resistance as the current varies is at once noticeable; hence it is seen, as will be further demonstrated, that we cannot take one reading and affirm that it be the true resistance of that portion of the earth, for when the slightest change takes place our result no longer holds good. It is an instantaneous value of the resistance. Note that the plates at

both stations lie within the older formation, the soil at (B) containing more iron than that at (A).

The above readings having been taken, the earth plates were disconnected and the well plates switched in. The surrounding circumstances and apparatus used were the same as before. Current was turned on at 60 volts and .4 of an ampere, giving a resistance of 150 ohms; at 70 volts and .437 of an ampere, it increased to 160 ohms. Now, the resistance increased uniformly with increase of current up to 187.7 ohms at 150 volts and .8 of an ampere, the average of the readings being 174.9 ohms. These results show the resistance to be much higher when the plates are placed in water than when simply buried in the earth; also, that the resistance increased a great deal more uniformly when well plates are used. The well and earth plates were now connected in parallel, and readings taken as before. The first, which was taken at 60 volts and .65 of an ampere, gave a resistance of 92 ohms, and increasing in the next to 93, but at the next reading fell to 80 ohms, and from this reading to the last the resistance varied between 80 and 79 ohms, the latter being the last reading.

Here we meet an exception to our rule of increasing resistance with current in that the last reading gave a lower resistance than the first. I shall endeavor to explain this later, but the advantage gained in having earth plates and wells connected in parallel over using them separately is at once noticeable.

The above tests being completed the line was short circuited for a few days, in order to get rid of any of the effects of the dynamo current that might remain, then allowed to remain open for a day.

The weather about the same as before and no appreciable change in the condition of the soil as regards moisture at a depth of from three to four feet below the surface. The apparatus and method of measuring resistance were changed. The dynamo current was no longer used, three Daniel cells being substituted. A Wheatstone bridge with a very delicate reflecting galvanometer was employed.

The strength of the battery current could be varied by means of a resistance box in series with the cells. The extremes to which the resistance would vary was even greater in this than in the preceding case, when the stronger dynamo current was used. With earth plates as grounds, by varying the current strength for each reading, the resistance varied all the way from 65 to 106 ohms. This great variation in results is no longer to be wondered at, in this case especially; for when the current is reduced very low, the cause is at once seen. The galvanometer—an exceedingly delicate one—under such circumstances seems to become unmanageable. The mirror jumps spasmodically, as though some one passed a magnet quickly before it. The unreliability of results so obtained is at once evident, for there seems to be an extra current in the line which acts in opposition to or in the same direction as the battery current, as the case may be, and the results are altered accordingly. Placing the terminals of the line to those of the galvanometer after the battery current had been withdrawn, the presence of such a current was at once shown by the bold deflection of the mirror.

The earth plates were switched out and well plates connected, the resistance in this case varying from 78 to 131 ohms.

The wells and earth plates being now connected in parallel, the resistance under this condition was found to be from 63 to 70 ohms.

Of course, the same battery current and apparatus were used in all three of the preceding tests.

(2) To find the resistance between one terminal station and the successive intermediate ones: The most interesting features and by far the most important ones to my mind are brought out under this head. A few cells of storage battery were employed this time, the current strength being varied by same means as before, though, however, the same Wheatstone bridge was used as formerly. Before the results are given, note the location of the stations in the figure, (A) penetrating just into the old formation, while (1) lies wholly within the drift, the two in separate strata. The current strength being changed each time the resistances were 183.3, 195.5, 212.2 and 221 ohms respectively. Thus it is shown that the resistance of the first 500 feet is greater than that of the whole 3,000. Disregarding the method employed, though not actually the same, all of the results are relatively the same. For example, under the first head the resistance when using wells with dynamo current was found to be higher than when using earth plates with same current. Now this is true whatever be the method employed for finding the resistance. One might suppose this high resistance of the first 500 feet to be due to the fact that the ground connection at (1) is not so good as that at (B), but when it is shown that the resistance between stations (A) and (3), a distance of 1,500 feet, is only 79.5 ohms, such a reason is at once insufficient.

Now, break the connection at (1) and connect ground at station (2) to the overhead wire, 1,000 feet from (A). By the same method as before the resistances were found to be 333.3, 355, 382.2 and 390 ohms; also higher than the whole portion, and as in the case just preceding, station (2) lies in the drift formation.

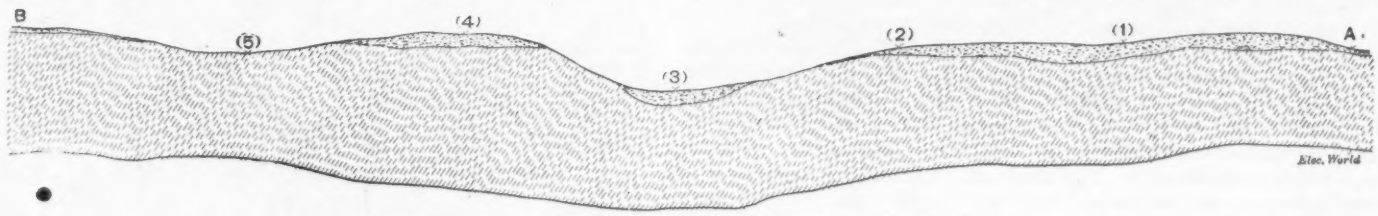
Hereafter, when it is stated that such a station is connected in, it is taken for granted that the one previously tested has just been disconnected. Station (3) is now connected in and quite a notable change takes place in the resistance, which was found to be only 63, 79.5 and 85.9 ohms. Station (3) is located in the valley, about thirty feet from the little stream. The ground connection at that station lies entirely within the alluvial deposit which directly overlies the older formation.

The portion between stations (A) and (2), a distance of 1,000 feet, has an average resistance of 381.6 ohms, while in the case above, a distance of 1,500 feet, we find the average resistance to be only 77.1 ohms.

Station (3) is damply located. Can we attribute the low resistance to that cause? If so, why is not the resistance between the well plates lower still, for here they are entirely surrounded by water?

These results prove very clearly the resistance of the drift to be much higher than that of the older formation.

Moreover, that there is a great advantage to be gained by placing ground connections in one stratum over placing them in another is at once evident and admirably shown by the following experiment, which I take from The Electrical World of April 14, 1894: "According to a daily contemporary, the Abbe Michel has succeeded in using two separate horizontal strata as a telephone circuit. The strata are conducting, and are separated by an intervening stratum of comparatively insulating material. By coupling the transmitter to a surface stratum and a deep stratum, and similarly coupling the receiver, it was found that speaking could be carried on at a distance of 120 feet. Very rarely would geological conditions permit of this arrangement being adopted, while in any case, of course, it would be impossible to have more than one system in the same locality."



CROSS-SECTION OF EARTH BETWEEN TERMINAL STATIONS.

Proceeding as before, the resistances between stations (A) and (4) were found to be 514.2, 555, 561 and 583 ohms, an average of 555.3 ohms. Notice the high resistance of this section and the location of (4). It is on a hill top, 2,000 feet from (A), and entirely surrounded to the drift formation, which attains quite a considerable depth in that locality.

This though only confirms the previous statements about the relative conductivity of the strata. Finally station (5) is connected in and the resistances found to be 217, 237, 328 and 353 ohms, an average of 225.8 ohms.

Being 2,500 feet from (A) station (5) penetrates both formations; the drift though is only superficial.

(3) How the resistance is affected by the polarization of the plates: Thus far we have dealt only with the resistance of the earth between the terminal and intermediate stations. We were attracted by the great variation in the results and the presence of an extra current in the line. This variation in resistance of the same portion of earth while using the same apparatus is certainly not due to any inaccuracy of the instruments, for they were tested with known instances repeatedly before and after each test. Polarization of the plates and ground connections is evidently the cause, because the effects produced are in every respect identical with those produced

by polarization: (a) When using a small current, the resistance was a great deal lower than when using a strong current. (b) When a current was sent through the line a second one was set up and shown to be quite strong when the terminals were placed to a galvanometer. To illustrate, take the ideal case where the plates were wholly immersed in a liquid. After passing a current through the line of not more than an ampere in strength and applying the terminals to those of a galvanometer, of course, after withdrawing the exciting current, if such it may be called, the mirror was deflected 29 cm. on a scale 34 cm., away from the instrument. The direction of this current was noticed, and the exciting current sent through the line in an opposite direction. By this process the galvanometer mirror was brought to a zero position; that is, the instrument indicated no current in the line for the time being. The exciting current was again passed through the line, this time setting up a current which caused a deflection of 30 cm. on the same scale. The existence of so-called "earth currents" has long been known, but such an hypothesis is unnecessary in the present case.

The polarization effects on the intermediate stations is all the more noticeable. The case taken above to show the effects was an ideal one, as was stated, the variation from which will be shown in the following cases: For example, take the case in which stations (4) and (A) were used, on the hill top. The deflection after using the same exciting current as before, and for the same length of time, was only 3.5 cm., while, on the other hand, when (5) was connected in, a deflection of 17 cm. was produced; and, furthermore, when (3) was connected in the deflection was 26 cm. The deflections produced by connecting in stations (1) and (2) were almost identical, being 4 and 4.5 cm. respectively. A plate similar to those in the wells was connected to the overhead line, as were the ground rods, and placed in the stream near (3)—the water running briskly over the plate. The same exciting current was sent through the circuit, the plate in the stream forming one ground and the plate at (A) the other, Upon removing the exciting current no reflection could be noticed.

(4) Is the resistance altered by using alternating currents? If so, how and to what extent? What we wish to find is the resistance of a portion of the earth without the effects of some local causes at the grounds. Now that we have attributed these disturbing effects to polarization, it only remains to employ some means that will be independent of polarization. By the use of alternating currents such means may be had. A method used in getting the specific conductivity of electrolytes was employed. This consists of the same Wheatstone bridge as previously used, though substituting for the battery and galvanometer an induction coil and telephone receiver.

In getting the resistance by the above method no perceptible variation took place in the results as by former methods, so it will be sufficient under this section to simply state in a tabulated form the results as they were obtained.

Resistance of earth between ground plates				(A) and (B)	92.4 ohms
"	"	"	"	well " " "	121 "
"	"	"	"	well plates and grounds in parallel	66.8 "
"	"	"	"	Station (A) and (1)	201.6 "
"	"	"	"	" " " (2)	374.7 "
"	"	"	"	" " " (3)	92 "
"	"	"	"	" " " (4)	506.3 "
"	"	"	"	" " " (5)	180 "

These, it may be said, are the true values of the resistance of the several portions tested; though I do not mean to say that all of the results obtained before were inaccurate; they are, as it were, the instantaneous values of the resistance.

The resistance of the earth as found in these tests is much higher than it is ordinarily believed to be. The matter of making ground connections is one that greatly depends upon local effects, hence every precaution should be taken to secure the best advantages. These are not to be secured, however, by placing the ground terminals in water or by simply placing them in any soil that seems to be a damp one, nor by selecting the driest soil possible, but plates or rods should be located in good conducting strata, and it should by no means be assumed that the earth is anything like a perfect conductor.

Electric Brakes.

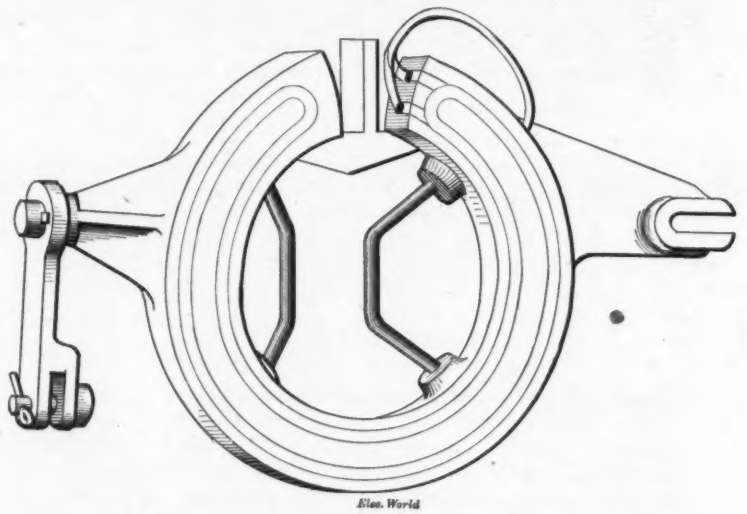
In a paper read at the September meeting of the American Institute of Electrical Engineers, Mr. E. A. Sperry discusses the qualifications necessary for a street car brake, and shows the superior manner in which these are supplied by an electric brake, of which a form invented by Mr. Sperry is described.

It is stated that nearly 85 per cent. of electric street railway accidents are due to the inefficient operation of brakes. With wheel brakes it is possible to bring a car to rest from a speed of 10 miles per hour within ten feet. The results of experiments on hand brakes are given, showing that with the full power of a man on hand brakes, exerting 180 pounds, a retarding effect of only 460 pounds can be developed, which is less than one-third that which is possible of being attained if the needful power were at hand, and which can be easily applied by electrical means.

The electrical brake invented by Mr. Sperry is illustrated in Figs. 1 and 2. The stationary part, shown in Fig. 1, is supported by the truck frame and centered on the wheel axle. When in operation it bears against a faced surface on the car wheel and brakes the latter, both through the friction due to the pressure of magnetic attraction and the torque created from the generation of eddy currents in itself and the wheel—the combination in this respect acting as a dynamo. In the grooves indicated in the cut is a coil of wire which receives current generated by the car motor acting as a dynamo after the trolley current is cut off and the brake lever is operated. In the opening of the brake ring is shown a graphite brush with which the braking surface is lubricated, it having been found by experiment that a greater braking power is thereby attained, due, according to Mr. Sperry, to the graphite through its conducting power permitting the eddy currents to circulate more freely between the wheel and brake ring surfaces.

The brake ring is so mounted, as shown in Fig. 2, that no weight whatever is supported by the axle, and all of the strain is borne by the truck framing; the method of support is such that gravity acts to retract the ring from the wheel face when current ceases to flow in the coil of the former.

The action of the brake is as follows: When the trolley current is cut off the moving car, the motor terminals, by means of the controller arm, are connected with the coil in the brake ring, the



Elec. World

FIG. 1.—STATIONARY PART OF BRAKE.

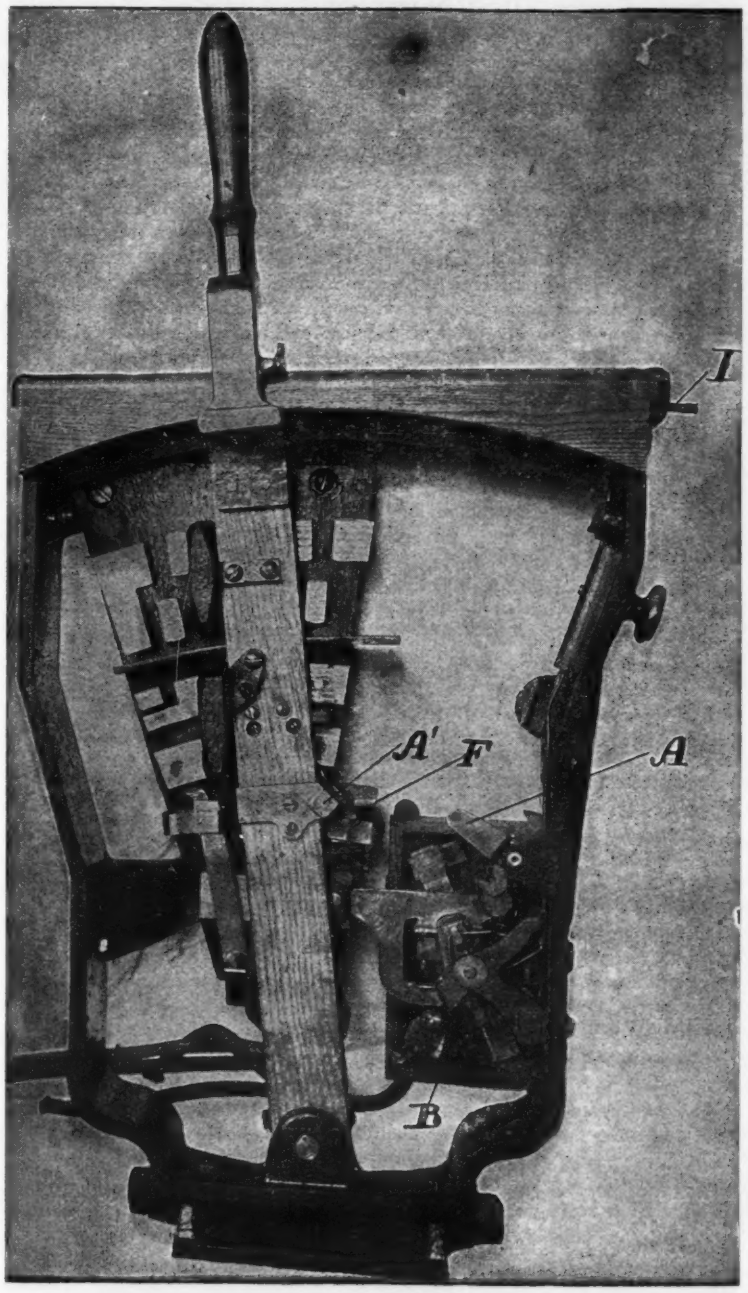
motor now acting as a dynamo. The current thus generated energizes the brake ring, which is then attracted against the wheel braking surface. The friction due to the magnetic attraction between the ring and the wheel retards the latter, and the wheel also acts as a magneto-dynamo armature in the generation of powerful eddy currents, thus creating a strong retarding torque. To this should be added the braking action of the motor acting as a dynamo, which, however, is small; a braking effect, for instance, equivalent to a pull of 2,432 pounds on a brake chain is produced by only 3½ volts at the motor, which voltage passes 16 amperes through the braking coil.

The brake is thus seen to be entirely independent of the trolley current, and therefore its action is not affected by accidents in the power house, sudden opening of circuit breakers, interruption of the line, flying off of the trolley, etc. Unlike the hand brake, the maximum retarding effect occurs at the highest speed, gradually decreasing with the speed. Owing to the high inductance of the braking circuit, the current does not cease flowing immediately the car comes to rest, the brake remaining on an appreciable time afterwards, thus not necessitating ordinarily the application of the hand brake even on heavy grades while taking on a passenger.

Figs. 3 and 4 illustrate the controller which has a single handle to accomplish all of the operations of starting, regulating, stopping, backing and braking. The controller handle is made to operate back and forth over the same contacts for controlling both the application of the current to the motor and braking the car. A self-correcting and interlocking device is also provided, shown at A, A',

Fig. 3, so if the motorman does not throw the handle clear over, the transformation is completed automatically before the movement of the lever can reach the operating contacts.

It will thus be seen that the brake is automatic and does its work without any special act or even the knowledge of the motorman, who simply works a single handle back and forth. Suppose the motorman wishes to stop his car, he turns off the current by simply swinging the lever over to the right. This operation is made to automatically convert the motor into a special dynamo for generating currents at very low speeds, and also simultaneously to cut



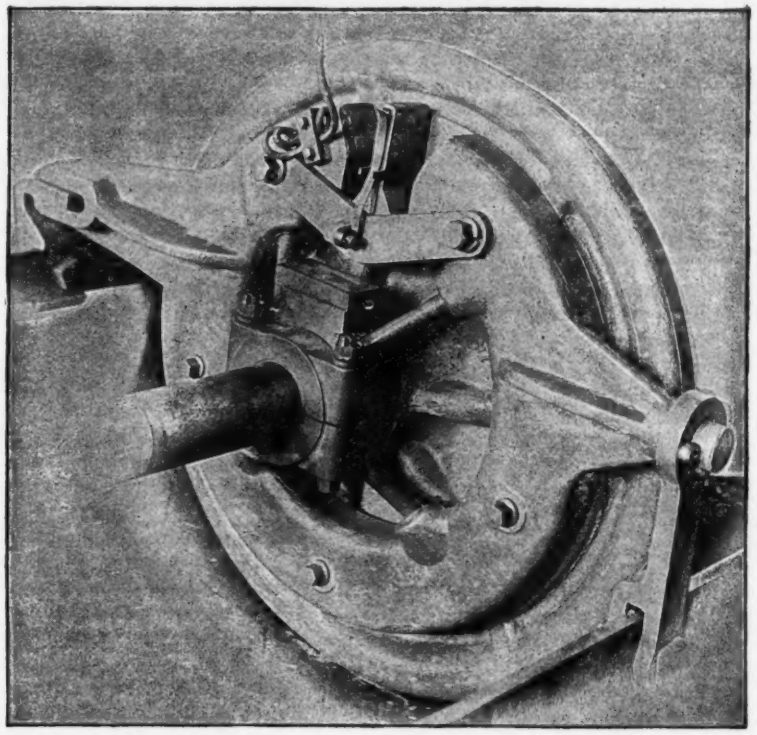
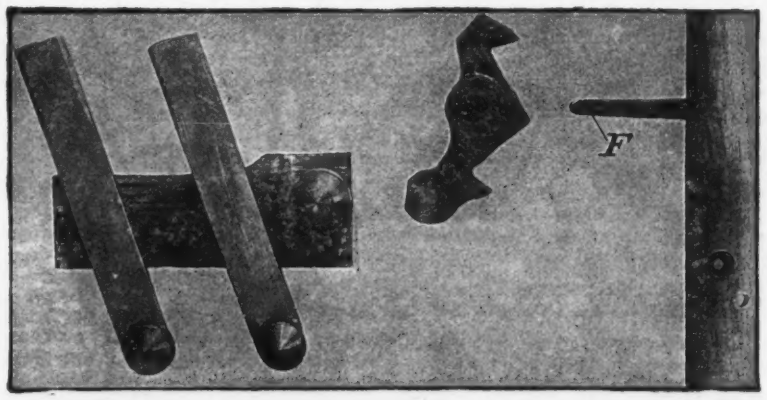


FIG. 2.—BRAKE RING IN POSITION.



FIGS. 3 AND 4.—THE CONTROLLER.

off all connection with the trolley current. The brakes are then applied by simply swinging the handle back over the path it has just traversed; the farther it is swung to the left, the stronger the brakes are applied. The act of releasing or letting off the brakes, again automatically re-establishes connection with the trolley and reconverts the dynamo into a motor. The switches used in part for the conversion of the motor are shown in Figs. 3 and 4, and are under the controller lever at A, the finger F mounted upon the lever forming a part of the alternate stroke operating device. The trolley brake switch B is shown open in Fig. 3. The same rheostat and contact are applied to control the motor while running the car, and also to control the slight amount of current generated by the transformed dynamo to brake the train.

The motorman cannot turn on the current before the brakes have been released, nor apply the brakes before the current is off.

The principal moving parts are simple and durable, being only two in number. An indicator, I, Fig. 3, at the right side of the controller, at the top, shows when the controller is in condition for brake, or is being so used.

The advantages claimed by Mr. Sperry for the electric brake, as compared with former brake systems, its qualities as an accident preventer, as well as its general commercial value, are recapitulated as follows:

1. The certainty of its operation. 2. The enormous power at instant command and under perfect control. 3. The absence of all power absorption at moneyed cost from the central station. 4. Its high efficiency, being far superior to compressed air; amply proven in numberless instances where electricity has replaced air. (The air requires a direct application of energy, amounting to an immense aggregate power absorption during the day from the central station; the working parts of the air machinery are attached to the car axles and require a large quantity of energy, not only while compressing, but at other times as well.) 5. Its extreme simplicity. 6. Saving in wheels two to three-fold. 7. Entire saving in brake shoes. 8. Lubrication of brake face; very little wear of either wheel or magnet. 9. Absolute silence of operation and release. 10. The low E. M. F. at which it operates. 11. The ease of its application and control. 12. Conserving strength, and prolonging the usefulness and life of the motormen. 13. The smoothness of its operation. 14. The fact that its use cannot cause flat wheels.

A Study of the Residual Charges of Condensers and Their Dependence Upon Temperature.*

BY FREDERICK BEDELL AND CARL KINSLEY.

When a condenser is subjected to a difference of potential for some time, part of the charge received is absorbed by the dielectric and a part remains upon the surface of the condenser plates. The part absorbed depends directly upon the duration of the time of charge; the part remaining on the surface is practically independent of the length of charge, for the condensers used in the present investigation. This latter part becomes discharged when the terminals of the condenser are connected together through a conducting circuit, and the condenser appears to be in a perfectly neutral condition. The absorbed charge, however, still remains in the condenser and will gradually come to the surface in the form of a residual charge of the same sign as before. If this be discharged, and the condenser be allowed to stand insulated, a second residual charge will collect in the same way as the first. A series of residual charges, with rapidly diminishing values, may thus be formed. Therefore, the condition of the condenser is dependent upon its past charges, some of which may have been held by the dielectric for weeks or even months before appearing upon the surface; a former charge of one sign may entirely neutralize a subsequent charge of opposite sign and smaller value. It has been justly said that the past history of a condenser must be known before it can be trusted.

The object of the present investigation was to determine this soaking-in effect of dielectrics. The condensers used throughout these experiments were furnished by Mr. Stanley in the spring of 1893, and were used in the experiments upon "Hedgehog Transformer and Condensers," described in a paper before the Institute, Oct. 18, 1893.

A study was made, first of the successive residual discharges of a neutral condenser and then of the effects produced by previously charging the condenser in the opposite direction. The absorption by the dielectric was next studied by allowing a charged condenser to stand insulated and discharge through its own dielectric. The effect of a previous negative charge upon this absorption and upon the apparent resistance of the condenser was then studied. An investigation was then made of the influence of initial potential upon the discharge curves, and the insulation resistance, followed by an examination of temperature effects. The influence of temperature changes upon discharge curves through various commercial oils, and upon the resistance of the oils, was ascertained preliminary to similar experiments upon condensers. Finally, the influence of temperature upon the absorption by the dielectric of a condenser was obtained by a study of the successive residual discharges, and by discharge curves at different temperatures.

The several parts of the investigation are separately discussed at length with reference to numerous curves, and the following conclusions are finally arrived at:

The action of a condenser is dependent, in a marked degree, upon its previous history; so much so, in fact, that its previous charges may be of more importance in determining its action under certain circumstances than charges received later. In that case the previous absorption, after neutralizing the absorption due to the final charge, may give rise to residual discharges which increase with time up to their previous initial value.

Absorption gives rise to the phenomena of residual charges and causes the condenser to depart from the exponential law in discharging through its own dielectric. The increase in apparent resistance in the condenser during discharge is associated with this effect of absorption. Previous charges modify these results, increasing or decreasing them according to whether the previous charges were in the same or opposite sense.

The resistance of pure oils is constant at any one temperature, but falls of rapidly with the temperature. There are, accordingly, no absorption or residual effects in pure oils.

In solid dielectrics the effects of absorption are diminished as the temperature is increased, as shown by the residual discharges and by the changes in the insulation resistance.

The authors state that this investigation can in no wise be considered as comprehensive. Many of the results described are already known, but they have not before been presented together so as to show the relation between them. The fact that the previous condition of the condenser has such an influence upon its action, causes considerable embarrassment in an investigation of this sort, inasmuch as a condenser used under certain conditions may be practically useless in the same investigation for further experiments. One of the condensers experimented upon, retained its past charges after being short circuited for a month, and it was necessary to employ another condenser which was neutral, for further experiments.

*Abstract of a paper presented before the American Institute of Electrical Engineers, September 19th, 1894.

Alternating Currents and Fuses.

The August and September number of the *Transactions* of the American Institute of Electrical Engineers contains the paper on "Alternating Currents and Fuses" by Prof. D. C. Jackson and R. J. Ochsner, of which we gave an abstract in our issue of May 26, 1894, accompanied by some remarks in criticism by Dr. Leonard Waldo and Sir David Salomons. It will be remembered that the conclusions of the paper were that, contrary to the statements made by Cockburn, Salomons, Matthews and others, the alternating current does not produce any disintegrating effect in fuses.

Dr. Waldo insists upon the importance of the results of experiments on fuse wires being accompanied by a chemical analysis of the metals used, and that the essential quality of a good fuse wire is that it should be homogeneous. Sir David Salomon adheres to his statement that fuse wire is apt to alter; and in his experiments he found that in no two samples of wire were the alterations the same, which was due chiefly to impurities in the metals tested. From an exhaustive series of experiments made on various metals and alloys at different temperatures and periodically cooled, he finds that they become more or less crystallized after a time, in which his experience agrees with that of others; also, that when the wire is in a crystalline or granulated form a larger current may be passed before the fuse gives way than when the fuse is new. One of the chief reasons why the alternating current appears to alter the fuse wire more than the direct current he believes follows from the variations in E. M. F. in the alternating system being greater than in the direct. He strongly advocates the use of tin wire for fuses, which is not only cheap but has proved very good in practice.

Prof. Jackson replies that the paper criticized was not intended to indicate what would be the best metal for fuses, but was simply an account of a series of careful tests of samples of metals taken directly from the factory. Of course, he says, if the fuse is not homogeneous—if it is made of cast iron or some such metal—the alternating current might possibly rack or crystallize it, but in the commercial fuses tested the results indicated that the effect of alternating currents is not injurious.

Alternating Currents in Direct Current Armatures and the Bad Effects on Machines.

BY G. J. SCOTT.

Having had occasion recently to examine several 80-kw, multipolar dynamos, I noticed that there was a tendency to spark, and for every fifth bar in the commutator to cut away as though the spark was particularly vicious at these points. Thinking that it might be loose connections, I examined closely and found that all connections wore good and tightly soldered. I then began to study the matter from a different standpoint, and found that it was due almost entirely to the action of alternating currents, a primary and a secondary.

The primary current was due to the fact that the armature bolts and spiders were not properly insulated, and as the armature is of the Gramme type, running outside of the field poles, and the armature bolts are on the outside of the armature discs, they cut the leakage lines from the armature poles. These poles are established between the field poles, both inside and outside of the armature rings, and the leakage increases with the load. The speed being constant and the field increasing with the load, the tendency is to shift the neutral line out of its normal plane and of itself cause a spark at all the bars. Those coils which are nearest and parallel to the armature bolts, have a secondary induced alternating E. M. F. in them at the time they are short circuited by the brushes. This E. M. F. depends for its value upon the ratio of the length of the armature bolt and the length of the armature conductor exposed to induction. As long as this matter is ignored by the manufacturers of this machine, just so long will it be an impossibility to make the machine sparkless, and make it compound properly on heavy loads, however nice it may operate on light loads with comparatively small armature reaction. This points out the importance of making armatures for large machines very carefully and using every endeavor to insulate the bolts from both the core discs and spider, and, above all things, of preventing, as far as possible, any closed circuits either of iron or brass in or about the armature body, which will either cut, or include and exclude lines of force. There are a number of good mechanical methods of suspending armature bodies from the spiders that are not expensive, and care should be used to

select the one that will satisfy all conditions. Care should be used on the part of the designer of dynamos of any type to apply first principles with good judgment and to seek for bad effects even if he is quite sure none will be found.

Where the ring armature is used, great attention should be paid to the way in which the bolts are put through the armature discs. The section should not be reduced any more at one point, or any oftener in the circumference than can possibly be avoided, as this in itself will cause a variable leakage and a consequent spark at brushes due to a moving neutral plane.

Sine Form of Curves of Alternating E. M. F.

To the Editor of The Electrical World:

Sir:—Although such questions as the one here discussed cannot be finally decided from theoretical reasons, since we are never certain that all conditions have been taken into account in the theory, still, there are some facts so well-established by practice and experiment that deductions made from them have almost the value of actual tests, and the writer therefore ventures to make the following remarks:

1. The only advantage which has been claimed for the non-sinusoidal curve of voltage is that the hysteresis is reduced, in the case of the first curve shown by the London "Electrician," (Fig. 1) about 10 per cent. This amounts to a saving of about 15 per cent. of the total energy transmitted. This saving only occurs with a peaked curve of voltage, the blunt curves having about the same amount of inferiority to the sine curve. It will be seen that the total amount of saving is insignificant.

2. The disadvantages which both peaked and blunt curves have compared with the sine curve are, first, increased eddy current losses; second, increased inductive drop; third, increased charging current.

The first of these is of little account in many cases, only rising into importance in special cases, so that we may neglect it.

With the second, however, the case is different. If we take the case of the line transmitting 1,000-h. p. a distance of five miles at a voltage of 10,000, we find that, under ordinary conditions of economical line construction, the inductive drop is at least about 30 per cent. of the resistance drop. Roughly, then the impedance factor for the third harmonic will be about 1.9, or, taking the case of the curve mentioned above, the actual number of volts cut off from the third harmonic curve is nearly 25 per cent. of that cut off from the fundamental, though the amplitudes are in the ratio of 1.7.

In regard to the third disadvantage, the charging current in the line will be increased more than 45 per cent. This means more than double the C^2R loss due to this effect, and also an increase of plant. On an overhead line, and with the insulators covered with a film of moisture, this would be a serious matter.

3. The disadvantages peculiar to the peaked form of curve are:

First, the greater cost of the line, or else a greater drop. Since the maximum voltage determines the insulation of the line, and since, if we have a peaked curve and a sine curve transmitting the same amount of power, the maximum voltage of the peaked curve, (in the case considered) will be about 15 per cent. higher than that of the sine curve, it is evident that we can, without having any more insulation on the sine curve line than on the other, increase the voltage on the sine curve about 15 per cent. This enables us to decrease the current about 13 per cent., and so to save no less than 25 per cent. of the C^2R loss in the line, while transmitting the same amount of power as the peaked curve.

Second, the peaked curve is not so efficient for arc lighting. This is probably due to the fact that a certain voltage is required to maintain the arc, and this voltage persists for a shorter time in a peaked curve than in a sine or blunt curve. This was first shown by the German experimenters in the paper referred to by the "Electrician."

The most important disadvantage peculiar to a blunt curve is that it does not give a regularly rotating field when used in two phases. If the maximum point of the third harmonic coincides with the maximum point of the fundamental, the field will rotate fairly evenly, while if the lowest point of the third harmonic, of the same magnitude, coincides with the highest point of the fundamental, the velocity will be irregular. To take an extreme case, a saw-tooth curve will give a fairly regularly rotating field, while a top-hat curve will give a field which moves instantaneously from a point on the field to one 90 degrees away, pauses there through ¼ of a period, and then suddenly moves through another 90 degrees. Under such circumstances, the efficient working of an induction motor is an impossibility.

Summing up we see:

1. That the *peaked curve* has an infinitesimal advantage over the sine curve in the matter of hysteresis.
2. For working induction motors it is nearly as good.
3. That it is very much inferior to it when the cost of the line to carry a given amount of power is taken into consideration.
4. That it is poorer for arc lamps.
5. That the charging current and C^2R loss are very much greater.
6. That the *blunt curve* is better than the sine curve for running arc lamps.
7. That it is very much inferior to it for running induction motors.
8. That it has a much greater charging current and C^2R loss.
9. That, were it not for the greater inductive drop, it would effect a saving in the line cost.
10. Neither the peaked nor the blunt form of curve permits of the use of condensers to neutralize self induction.

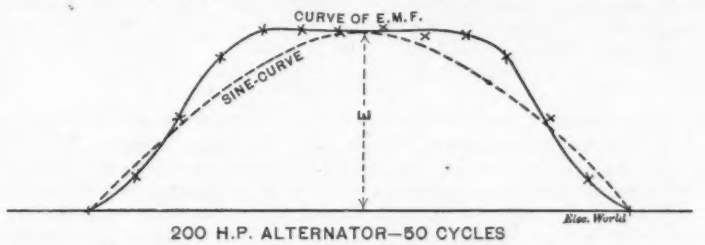
On the whole, it will be seen that the sine curve has the balance of advantages in its favor, and is more generally adaptable than either of the other forms.

With regard to the remarks of M. Blondel, concerning the permanence of the sine form of curve, I would say that if a sine curve is put into the primary of any well designed transformer, a very close approximation to a sine curve will come out of the secondary, except at very light loads, and that in the transformers experimented upon by M. Blondel, the iron must have been worked at a higher induction than is usual, or else the hysteresis losses per cm^3. must have been greater than is usual in good iron.

Pittsburg, Pa. REGINALD A. FESSENDEN.

To the Editor of The Electrical World:

Sir:—In my opinion the form of the curve of alternating E. M. F. has rightly received much attention and a builder of alternators should determine experimently the E. M. F. curve of every type of apparatus constructed. I enclose the



200 H.P. ALTERNATOR—50 CYCLES

CURVE OF OERLIKON ALTERNATOR.

E. M. F. curve of an Oerlikon alternator, the armature coils of which are fastened on iron teeth which become broader toward the toplike the pole pieces of a dynamo. The top of the curve is flattened and for a long distance a straight line. The sine curve having the same amplitude E, is drawn in dotted lines. It is evident at a glance that the E. M. F. curve has a greater mean ordinate than the sine curve, the former being nearly 1.1 as great as the latter. In order to obtain the same mean ordinate for the sine curve the amplitude would have to be about 15 per cent. greater. The work done is, however, propotional to the square root of the mean square of the E. M. F., and the difference is therefore greater than 10 per cent. against the sine curve. The energy of magnetization in transformers will, however, be nearly the same for both curves.

It follows, therefore, as regards the demands of insulation and the work of magnetization in transformers and motors, that the above curve of E. M. F. is preferable to the sine curve. But also in practical use of both single and multiphase motors, it has never been proven that a different form of curve would give better results, although motors built at Oerlikon for 40 to 100 cycles have been supplied to central stations whose generators have been of vastly different construction from those of the Oerlikon works.

According to our experience, therefore, it is altogether unnecessary to attempt to obtain a sine curve. Every designer may rest satisfied if he obtains a curve the mean ordinate of which is at least equal to that of the sine curve of equal amplitude and the rise and fall of which is uniform. In the so-called iron clad alternators, which are becoming more and more popular because of their greater output per unit of weight and their smaller exciting current, a closely approximating sine curve of E. M. F. can never be contained. E. ARNOLD.

Carlsruhe, Germany.

DIGEST
OF CURRENT TECHNICAL ELECTRICAL LITERATURE
COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS
BY CARL HERING

ELECTRO-PHYSICS.

Electricity Considered as a Whirling Movement.—In a French Academy paper by Mr. Zenger, reprinted in "L'Elec." September 8, he describes a number of experiments tending to show that an electric discharge produces a whirling motion of material in the electric field; a discharge through the fumes of the vapors of ammonia and hydrochloric acid shows these whirls; in another experiment two small pieces of tinfoil are pasted on a photographic plate, which was covered with a light brown layer of lamp black; after the discharge between the two pieces of foil a white trace was found, which was larger in the middle, while there was a black line through the middle of it; he believes this demonstrates that electricity causes the molecules to describe a trajectory entirely different from that of light; the effect in the latter can be represented in general by a screw of invariable pitch, traced on the surface of a cylinder, whose base is circular or eliptical, while that of the electric movement can be considered as a screw traced on a conical surface with a variable pitch, the spires of which are enlarged toward the middle of the discharge. Several other similar experiments are described with a silver mirror; also the effect of a bolt of lightning on a mirror.

Capacity of Condensers with Alternating Currents.—An illustrated paper by Dr. Sahulka is published in the "Zeit. feur Elek.," September 1; it appears to be the same as that abstracted in the Digest, January 20, an English abstract of which was referred to March 17.

Resonance and Interference.—Mr. Trowbridge's paper from the "Phil. Mag.," for August, is abstracted briefly in the Lond. "Elec. Rev.," September 7.

MAGNETISM.

Magnetization Curves.—The "Elek. Zeit." September 6, publishes the results of recent tests made by the firm of Krupp in Germany, with dynamo steel, cast iron and Swedish charcoal sheet iron; a set of curves showing the hysteresis loop is published for each and the numerical results are given for the first. A second set of curves for the relation of the permeability and the induction is given in each case, deduced from the hysteresis curve and which "do not represent the permeability, but the quotient of $\mathfrak{B}$ by $\mathfrak{H}$." This second set of curves have a peculiar shape and it is questioned whether such a method of representing the curves is of any practical value, as it is stated that they do not represent the permeability, but that the relation here is similar to that in the methods in which the internal resistance of a battery is measured when the polarization is included as a part of the resistance.

Magnetic Qualities of Asbestos.—The Lond. "Elec.," September 7, states that Mr. Swinton has found that an asbestos mill-board can be lifted by a strong magnet, and that it is possible to magnetize it, thus showing that this material is not suitable for delicate magnetic instruments.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—In the "Elek. Zeit.," September 6, Mr. V. Hefner-Alteneck replies to the article of Messrs. Lummer & Kurlbaum, which was abstracted in the Digest last week, in defence of the adoption of the Hefner amylacetate lamp as a physical standard of light. He does not approve of the distinctions made between the terms "physical" and "technical" standards when applied to his lamp and claims that it is just as much a physical standard as the new platinum standard of Lummer & Kurlbaum; his lamp should not be ranked with the candle, carcel lamp, etc., as these are really only sources of light and not real units; his lamp is a true unit by itself, and should not be used as a secondary standard; when he originally proposed it 10 years ago, it was with the intention that it should be adopted as a unit; although the new platinum standard may admit of a greater accuracy, it is based like others only on an arbitrary system and not on the C. G. S. system, and it requires complicated and delicate apparatus, together with a considerable application of skill in its handling.

Standard Units.—The first portion of an article is published in the Lond. "Elec. Rev.," September 7; it is a brief acknowledgement of the work of the B. A. Committee.

Terms.—The Lond. "Elec.," September 7, editorially suggests that the old term "volt-ampere" might be used to represent the products of the volts and amperes in alternating current circuits in which the lag is neglected, thus distinguishing that product from the true watts.

Indicating a Fault in a Submarine Cable.—In the Lond. "Elec. Rev.," September 7, Mr. Rymer-Jones describes in detail, together with diagrams, a new zero method for determining the position of a fault in a submarine cable between the repairing ship and the shore when the conductor is not broken; it is based on the principle of the fall of potential; the method has been used with success and he believes it to be the first method described in which the test might conveniently be carried out on board ship; the description does not admit of being abstracted.

Harmonic Analyzers.—The Lond. "Elec." September 7, reprints a British Association paper by Prof. Henrici on integrators, harmonic analyzers and integraphs; it is not the same paper which was published in the "Phil. Mag," for July, although it contains a description of one of the machines mentioned in that paper.

Pocket Galvanometer for Telegraphers.—A simple form of instrument is described and illustrated by Mr. Mixa in the "Zeit. feur Elek.," September 1.

Laboratory in Paris.—The Lond. "Elec. Eng.," September 7, gives a brief description of the history of the Central Electric Laboratory in Paris.

DYNAMOS AND MOTORS.

Self-excited Alternators and Alternate Current Motors.—The "Elek. Zeit.," September 6, contains an article by Mr. Teege on the influence of self-induction on the field excitation of alternating current machines. He calls attention to the desirability of making alternators self-exciting, mentioning some suggestions that have been made and then proceeds to discuss mathematically at some length a method proposed by himself; it consists essentially in generating in the alternator three entirely separate currents, having a phase difference between them of 60°, each of these is then rectified by means of a commutator and each of the three currents then circulates independently and insulated from the others, around the field magnets; there are two advantages, one of which is that the magnetising force will be three times as great, and that the production of sparks will be only very slight; during the time when the first current is commutated the second and third continue; the commutation of one current can therefore only produce a slight change in the number of lines of force, for which reason the commutation will be almost without sparking; the currents for the excitation of the field have no connection with the main external circuit; the application is specially suitable for three-phase generators. He discusses only the theoretical side of the question and considers first the simple case of two currents with 90° phase difference; after an analytical discussion, accompanied by graphical diagrams, he applies the results and shows that the sum of the two currents (about 25.5 amperes) is very nearly constant and that the current at the moment of commutation is only 2.73 amperes, while if there was only one single phase current it would have been 12.6 amperes. To show the small effect of the self-induction he calculates the results for the extreme cases of a self-induction of zero and one of infinity and finds that between these extremes in the self induction the current at the time of commutation varies only between zero and 2.73 amperes, while with a single-phase current the variation would be between zero and 12.73 amperes. Another advantage is that if the magnetic density is 10,000 or more per square centimeter, variation in the current will not produce a very marked effect on a change in the number of lines of force; the coefficient of self-induction will then be far below the value which he assumes. He then considers in the same way three currents of 60° difference in phase, and shows that the sum of the currents (about 38 amperes) has become practically constant and the value of the current at the moment of commutation is now only 1.181 amperes, while for the extreme case of an infinite self-induction it would be only 1.184, showing that the influence of even enormously high self-induction is negligible. He shows that the minimum sparking will take place at an extremely small shifting of the brushes and that in practice it is independent of the self-induction in the winding of the field magnets. For this reason he suggests to build motors similarly to generators, which can be done in two ways; in the first case the generator and motor are exactly alike, having this independent winding on the armature for excitation; if the three-phase current is sent into the main winding of the armature the motor will start, if not loaded too heavily, and will reach a synchronous speed; a three-phase current will be induced and will excite the magnets, after which the motor will run synchronously; in such a motor a greater density in the iron can be used than in three-phase motors, and it is free from the

objections due to the self-induction in ordinary alternate current motors; in the second case the field magnets are excited from the source and the motor is allowed to reach a synchronous speed, after which the magnet windings are connected to the external circuit (the description is not quite clear) which presents no difficulties, as the coils in this arrangement are quite safe and free from self-induction; both kinds of motors can be used also as generators and they are inferior to continuous current motors only in that they will not start when fully loaded. He mentions briefly another application of this method in the rectrification of currents and in the application to charging accumulators by the method of Mr. Pollak, in which the interruption of the current takes place when the counter E. M. F., of the cells and the direct E. M. F., of the line balance each other.

Coupling Alternators in Parallel.—An arrangement deivsed by Mr. Kapp is described by him with the aid of a diagram, in the "Elek. Zeit.," September 6. He states that the parallel running of alternators has become the rule during the past years and that the use of independent machines, each having its own circuit, has shown itself to be too complicated, having the disadvantage that the machines in general run under more unfavorable conditions than with parallel running; practice has shown that all good modern alternators can be coupled in parallel; when difficulties arise they are not due to the alternators, but to the source of power. With the present method of coupling alternators quite a little experience is required and there is often a loss of time in making such connections; to overcome this he designed the arrangement which he describes, and which has been in successful use in the Bristol station. It consists in general in first connecting the machine which is to be coupled, to the circuit through two choking coils in series; the choking coils are so designed that with double the voltage of the machine, somewhat less than the normal machine current will pass through them; when the machine has reached nearly its proper speed current will begin to flow through the choking coils and this current will quietly force the machine to the proper speed; one of the coils is then short circuited, which will increase the current and will force the machine nearly into the same phase; when the second coil is short circuited, there will be another increase in current, which will force it completely into phase, after which the machine is connected directly to the mains. With this apparatus a machine can be coupled, as a rule, in about 20 seconds and requires no other precaution than to close the switches in the proper succession; the choking coils need not be very large, as the current which flows through them is only of very short duration. A somewhat similar apparatus is used by The General Electric Company, in which, instead of short-circuiting the choking coils, a copper cap is moved over the coils to diminish their self-induction

Tests of a Non-synchronous Motor.—The "Elek. Zeit.," September 6 reprints from the Italian, a table of results of a very complete test made by Mr. Arno with a Brown non-synchronous motor (see Digest, Feb 25, 1893) of 15-h. p. The motor starts as a multiphase motor, after which it runs as a non-synchronous single phase motor; it weighs 1,200 pounds and runs at a speed of 800 revolutions at 150 volts and 40 periods; to start it takes 20 seconds, during which time it is running with a loose pulley. A table and several curves are given, from which it appears that the maximum commercial efficiency was 88 per cent. at about 12-h. p. falling from there to 74 per cent. at 6.7-h. p. The results are considered favorable, but it is claimed that it should have been rated only as a 12-h. p.; there is a very rapid falling off in the efficiency at overload, it being 15 per cent. for a 10 per cent. overload; no figures are given for greater overloading unfortunately. (Similar tests of a smaller motor of this kind were abstracted in the Digest January 20).

Dynamos for Electrolysis.—In the "Elek. Zeit.," September 6, Mr. Dahlander gives a brief description of the large 220-h. p. dynamos used in a large installation in Sweden; they run day and night at 115 volts and 12 amperes and are absolutely sparkless; the magnetic field is ex extremely strong and the pole pieces are split in a plane parallel to the lines of force in the field, but perpendicular to those in the armature, in addition to which the Sayers' method (see Digest, June 10-17, July 1), 1893, is employed. The installation is for the production of chlorate salts, according to a newly discovered process, and is an exceptionally large one, containing 8 of these machines, to which 10 more are to be added.

ARC AND INCANDESCENT LIGHTS.

Efficiency of Incandescent Lamps.—An abstract from a forthcoming work by Dr. Fleming is published in the Lond. "Elec.," September 7; it is in the nature of an interesting summary, but contains nothing new. He shows how the luminous efficiency, that is the efficiency of transformation of the electric current into light, can be determined for the incandescent lamp, stating that it varies from 3 to 7 per cent.; reference is made to the experiments of Mr. Merritt of Cornell University. He considers the changes that go on in a lamp during its life, giving curves from a paper of Prof. Nichols of Cornell University. Regarding the so-called "smashing point," he states that it is not always advisable or necessary to replace a lamp when this point has been reached, because if the lamp is giving light enough then, although its candle power is diminished also, the total sum which is being paid by the consumer for the energy is, on the whole, diminished and therefore the lamp is costing the consumer less on the whole to maintain in action, than a new lamp would do if it replaced the old one, although the cost of the lamp per candle light may be considerably increased. He gives two tables containing the candle-power of lamps when used at varying voltages, showing how enormously the light varies with the voltage.

Alernating Current Arc.—The Lond. "Elec.," September 7, reprints from a book recently issued by the Helios Company, some curves showing the distribution of the light from alternating current arc lamps under various conditions. In one case the current for two lamps was the same, but the voltage in one was 28.5, and in the other 32.5; they showed that with an increase of 14 per cent. in the volts and nearly 10 per cent. in the watts, there is a decrease of more than 15 per cent. in the spherical candle-power. Another diagram shows the candle-power with different currents, the voltage being in each case that which was best for the particular current; the voltage increased from 25 to 30 while the current decreased from 50 to 8; it seems from these curves that a 10 ampere lamp is very inefficient when compared with larger ones. A third diagram shows the effect of a reflector of that company, which consists of a white enameled iron disk placed immediately above the arc and just large enough to reflect the rays which would pass upward; two curves are given, one with and one without a reflector; in the former case the spherical candle-power was 275, and in the latter the hemispherical candle-power was 498, the consumption in both cases being 310 watts.

Reflectors and Reflection.—An editorial under this heading in the Lond. "Elec.," September 7, calls attention to the great increase in the amount of light in interior illumination due to the reflecting character of the walls and ceilings; referring to the results obtained by Dr. Sumptner (see Digest, March 4, and The Electrical World, March 18, p. 205) it states that if the walls and ceilings were well whitewashed, for instance, the light in the room would be increased five-fold (presumably over that which it would be if the walls were black or if the lights were in the darkness of the open air. It states that if the business of an electric light engineer is to provide light and not merely to sell dynamos and lamps, it is his duty to attend to the use of reflectors and reflection. It states that for street lighting reflectors are of no use whatsoever in connection with continuous current arcs.

Diffusion of Light.—The translation of a paper by Mr. Wiener from the "Wied. Ann.," vol. 47, p. 638, is published in the Lond. "Elec.," September 7. It is of scientific rather than of practical interest, dealing more particularly with the imitation of brightness in paintings. After giving some historical data he describes some tests made about 10 years ago with light which was diffused and reflected from surfaces of cast plaster of Paris; a number of curves are given showing the quantitative determination of the diffusion at different angles.

TRANSMISSION OF POWER.

Transmission of Power.—A translation of a portion of the article describing the alternate current transmission plant at the Menier farm, abstracted in the Digest, June 9 and 23, is published in the Lond. "Elec. Eng.," September 7, from the Journal of the Institution of Electrical Engineers; tables of data of the motor tests are given.

ELECTRIC RAILWAYS.

Working Expenses of Railways.—The Lond. "Elec. Rev.," September 7, reprints the first part of an article from the "Railway World," in which are given and discussed tabulated data of the expenses reduced to the train and car miles, of the Liverpool, the City and South London, the Birmingham accumulator and the South Staffordshire trolley lines; the results are of interest, but do not admit of being abstracted and some of the conclusions have been published before. The per cent. of expenses to receipts per train mile in the Liverpool line for the year ending last June, was toward the end of that year, 75 per cent.; for the City and South London line it was 79 per cent. in 1891, growing gradually less and being 62 per cent. in June, 1894; for the Birmingham accumulator line the percentage per car mile was low at first, but was slightly over 100 per cent. for the last three years, showing that the road is now being operated at a loss; the results for this line are discouraging; for the South Staffordshire line the percentage is not given. Data regarding cable lines are to follow.

Utilizing the Energy Lost in Braking.—In an article in the "Elek. Zeit.," September 6, Mr. Baumgardt calls attention to the amount of power lost in the brakes of an electric line and calculates the percentage in an assumed case, showing how much of it could be recovered and utilized. The motor must have a magnetic field, the polarity of which is independent of the armature current; he assumes a route with 12 different grades and calculates the energy taken from the line on upgrades and levels and that restored to the line on the down grades, for assumed speeds; in this particular case in which the grades are from a level to 10 per cent, and thence back to a level again, he finds that 31 per cent. of the energy will be saved on a complete trip, if the motor is used as a brake to restore current to the line; in practice this percentage will be somewhat smaller on account of the effect of curves and stoppages. He gives the general expressions for calculating these results and illustrates the deductions by an application.

Electric Traction.—The report of Van Vloten to the Permanent International Street Railway Union, is abstracted briefly in the "Elec. Zeit.," Sept. 6. On Jan. 1, 1894, there existed in the United States 12,029 kilometers of electric railways, with 18,200 cars, while in Europe

the corresponding figures were 309.9 and 706; in Germany there were 102 kilometers. In the United States the total number of kilometers of street railways at that date was 19,326, of which 5,327 were run by horse-power, 1,059 by cable and 911 by steam (a kilometer is equal to .621 mile). He believes that the arguments against the unsightliness of the overhead wires have been exaggerated abroad; he states that in changing a horse-car line into an electric line an increase of 20, 40 and even 80 per cent. in the receipts have been obtained.

Self-motive Carriages.—"La Nature," Aug. 25, contains a description with illustrations, of the prize winners in the recent competition in Paris of carriages that contain their own motive power; none of these were electrical; a brief summary is published in the Lond. "Elec. Rev.," Sept. 7.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Automatic Regulator.—In "L'Elec.," Sept. 8, Mr. Rechniewski describes the Postel-Vinay regulator for keeping the potential at the voltage of the lamps constant and indpendent of the speed of the machine or the loss in the feeders. It consists of a detector which closes one circuit when the voltage is too high and another when too low, these circuits, operating magnetic vibrators which, with a pawl and ratchet, turn the sliding contact of a series of wire resistances in one or the other direction, the resistances being included in the field circuit.

Automatic Controller of Currents.—In an article by Mr. Leroy in "L'Elec.," Sept. 1, he enumerates the objections to fusible and magnetic cutouts, and points out the advantages which a good reliable maximum current cut-out would have, especially in connection with central stations in which a charge is made on the basis of a maximum number of lamps; no description of such an apparatus, however, is given.

Series Incandescent Light System.—A further description of the Goldston system, described in the Digest last week, is published in the Lond. "Elec. Rev.," Sept. 7; the dscription is not very clear.

Refuse Destructors.—In a communication to the Lond. "Elec. Rev.," Sept. 7, Mr. Baker gives some brief statements regarding his system; he states that he fails to see how it is possible that all of the electricity required for the lighting of a town can be generated from the refuse of that town without any expenditure of other fuel.

Train Lighting.—An illustrated description of an accumulator system installed on a number of cars in Germany, is published in the "Elek. Anz.," Sept. 2.

Central Stations Run by Gas Engines.—A brief description of the Reims station, which is said to be one of the most perfect of its kind in France, is described briefly in "L'Elec.," Sept. 8.

WIRES, WIRING AND CONDUITS.

Laws Regarding Electric Conductors.—A report on the proposed French laws by Mr. Berger is published in full in "L'Elec., Sept. 1 and 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Pacific Cable.—Two statements from the London Times regarding the proposals for manufacturers, together with Mr. Sandford Fleming's estimate concerning the capacity, are published in the Lond. "Elec. Rev.," and "Elec.," Sept. 7, including a short editorial discussion. The Lond. "Elec. Rev.," Aug. 31, also contains an article on the Pacific cable.

Telephony.—The article by Mr. Baumann (see Digest, Sept. 15) is continued at some length in the 'Elek. Zeit.," Sept. 6.

ELECTRO CHEMISTRY.

Chlorate of Potash.—"L'Elec.," Sept. 1, abstracts an article by Mr. Korda on the electrolytic manufacture of chlorate of potash; he describes the process briefly, the chief advantages of which are that hydraulic power may be used, that only a single material, namely, chloride of potassium, is required, and that there is no residue, while with the chemical process quite a number of materials are required. He mentions an installation in Switzerland which has been running for four years and which is one of the largest factories driven by water-power in Europe.

Large Electrolytic Installation.—The "Elec. Zeit.," Sept. 6, describes the dynamos at a large installation in Sweden in which chlorate salts (chlorate of potash for making matches) are produced by a newly discovered electrolytic method; there are at present 8 dynamos of 220-h. p. in use and 10 more are to be added; water-power is used to drive the dynamos.

MISCELLANEOUS.

Ozone Generator.—A new apparatus of Messrs. Bonetti and Seguy is illustrated and described in "L'Elec.," Sept. 8. Discharges from an influence machine take place in a closed receptacle through which the air or oxygen to be ozonized is forced; it is said to be of importance that the two knobs between which the discharge takes place shall have different diameters in order to obtain the maximum effect, the negative knob being the larger one. In the industries the apparatus can be used for numerous applications, for the rectification of alcohols, the artificial ageing of spirits and wines, as also of woods or musical instruments, for bleaching, sterilising, disinfecting, etc.: by using an influence machine the price of the apparatus becomes much less than that of the one ordinarily used.

Blackening of Walls by Conductors.—In a communication to the Lond. "Elec Rev," Sept 7, the recent statement of Nellis is claimed to be incorrect, (the statement was that the blackening occurs when the current is continuous and not when it is alternating); two marked cases are mentioned in which the current was alternating; attention is called to the fact that hot water pipes and incandescent lamps blacken walls and ceilings and it is suggested that the simple explanation of the hot air rising will suffice to explain them all.

Treatment in Case of Accidents.—In a communication to the Lond. "Elec. Rev.," Sept. 7, Mr. Kolle suggests that the Institution of Electrical Engineers should be asked to prepare instructions, dictating the best method of treatment, the instructions being printed on cards of convenient size for handling and posting in prominent places, containing illustrations and a simple, clear, concise statement of the best steps to be taken to restore consciouness; such a card should be placed near every main-switchboard and in each testing room; the suggestion is endorsed editorially.

Lightning.—A French Academy paper by Mr. Berger, published in "L'Elec.," Sept. 8, describes and discusses a lightning discharge of great magnitude noticed recently in Prague; he mentions a photograph, which, however, is not reproduced; there were six distinct bolts which struck four buildings simultaneouly; a curious phenomena shown on the photograph is that the shadow of the cupola of a building was projected on the sky.

Flying Machine.—The "Elek. Tech.," Aug. 31, states that the recent experiments with the Wellner machine proved a failure; it is said to have lifted 350 kilograms with an expenditure of 12-h. p., the weight of the engine being 90 kilograms, and it lacked a force of 540 kilograms to raise itself.

Flywheel Accumulators.—In a reply to the Lond. "Elec.," Aug. 31, Mr. Swinton claims that experience is better than theoretrical consideration and shows that a peripheral speed of 611 ft. per second is obtained in the fly-wheel of the Howel torpedo, 575 ft. in the Laval steam turbine and 590 ft. in the Parsons turbine; he believes it very doubtful whether wheels with hoops shrunk around them or bound with steel wire, would offer any appreciable advantage over a solid steel wheel.

Sealing Bottles Electrically.—According to the Lond. "Elec. Eng.," Aug. 31, a French journal suggests coating the neck and cork of Champagne bottles with copper, nickel or aluminium, so as to close the pores of the cork, making a perfect seal and providing a metallic capsule. 5 per cent of the champagne, as now bottled, is lost by defective corking. The same article suggests the preservation of butter, which, after being covered with plumbago, has a film of copper deposited electrically.

Exhibition of 1900.—"L'Ind. Elec.," Aug. 25, reprints some of the official documents of the coming exhibition, including those concerning the rules, awards, classification, etc.

Prizes.—The subject for which prizes are offered by a French society for the years 1895-96, are given in "L'Ind. Elec.," Aug. 25. A translation of the particulars regarding the prizes offered by a Fernch society are given in the Lond. "Elec. Rev.," Sept. 7.

Biographical.—A sketch of the life of the late Carl Grawinkel, is published in the "Elek. Zeit.," Aug. 23.

New Book.

THE MINERAL INDUSTRY. Its Statistics, Technology and Trade From the Earliest Times to the close of 1893. Statistical Supplement of the Engineering and Mining Journal. Edited by Richard P. Rothwell. New York: The Scientific Publishing Company. 894 pages. Price $5.00.

The second annual volume of this valuable work brings the statistics relating to the mineral industries down to the close of 1893. Those connected with this important branch of our national wealth are to be congratulated upon having such a great mass of statistical, industrial and technical information placed within their reach as is to be found in the 894 large pages of this book. The plan of the work and its thoroughness may be judged from the following contents of the section devoted to copper: The opening portion reviews the copper production during the year 1893, by states and countries, with special references to the output, cost of operating, etc., of the larger mines, and accompanying tables of statistics enable comparisons to be made for a number of years. A special article by A. R. Ledoux discusses "The Future of Copper Production in Montana," and other special articles are on "The American Copper Market in 1893," "The London Copper Market in 1893," "Improvements in the Metallurgy of Copper" by E. D. Peters, Jr., "American Practice in Electrolytic Copper Refining" and "Present Practice in Copper Concentration and Extraction," by Titus Ulke, "Thofehrn's Improved Electrolytic Process," by Hippolyte Fontaine and "The Cupreous Chloride Process," by C. Hoepfner. Other sections in the book of more or less interest to the electrical profession are those on mica, zinc, ozokerite, asbestos and slate. There are also accounts of electrolytic processes employed in reducing various metals.

A Modern System of Block Signals.

Railroad officials, and especially those who have had their positions since the time when a speed of 16 miles an hour was considered a wonderful achievement, have been rather slow to adopt the safety appliances that the modern thought have devised. The tremendous increase of both freight and passenger traffic, together with the high rate of speed at which many of our trains now run, has resulted in the building of two and in some cases four parallel tracks to accommodate the

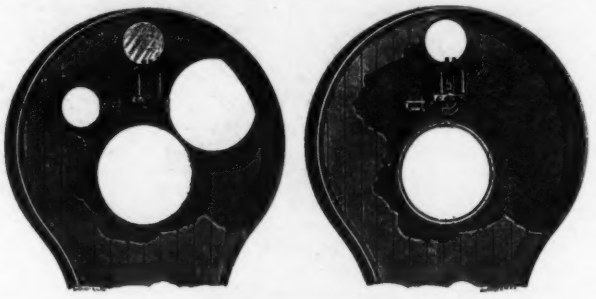


FIG. 1.—INTERIOR OF SIGNAL CASE.

business and reduce the possibility of collisions. While two or four tracks will, in a great measure, insure against the possibility of a head end collision, the colliding of trains running upon the same track in the same direction is in no way eliminated.

Many ingenious devices have been brought out to overcome these dangers, and even after having been practically demonstrated to be valuable adjuncts to any railway, we find that they are seldom adopted by a road until some serious disaster has overtaken it and its treasury drawn upon to indemnify the injured and the relatives of the dead for an amount that would have completely equipped the line with safety signals.

One of the most efficient of such devices is that originated by the Hall Signal Company, of No. 80 Broadway, New York, and a description of its latest system of signals, known as the Hall Automatic, Normal

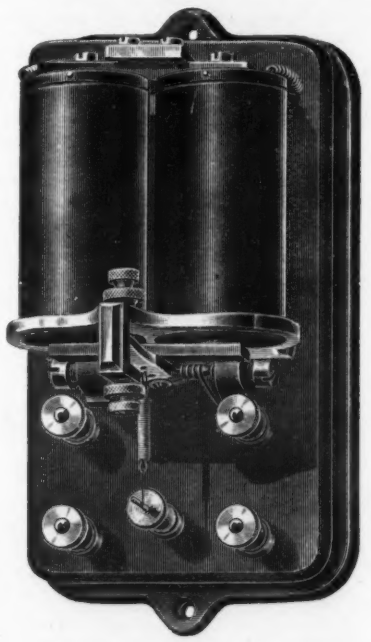
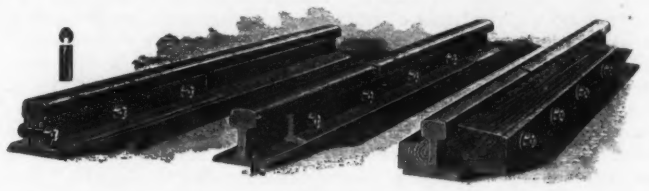


FIG. 2.—THE PERFECTED RELAY.

Danger Track Circuit, Block Signal System, may prove of interest at this time.

On completing the work for the Delaware, Lackawanna & Western Railroad the Hall Signal Company extended an invitation to a number of interested railroad officials to make a tour of inspection. On September 12th a special train consisting of engine, coach and dining car had been placed at their disposal by the railroad company. Among those in the party were the following: Messrs. A. Reasoner, general superintendent D., L. & W. R. R.; W. H. Lewis, superintendent of motive power; William Unroh, civil engineer; Solomon Griffith, superintendent bridges and buildings; F. J. Griffith, division superintendent; P. H. Brangs, chief electrician; James Dalrymple, chief train despatcher; J. Frank Emmon, president Rapid Transit of L. I.; F. S. Gannon, general manager; Mr. Peddle, division superintendent N. J. Central R. R.; William P. Hall, president Hall Signal Company; Melville P. Hall, secretary; C. W. Brewster, sales agent; W. W. Salmon, engineer and Western agent, Chicago. Besides these were a number of newspaper representatives. The trip consumed about four hours, during which time excellent lunch was served, washed down with a liberal supply of "Mumm's Extra Dry."

The distinctive feature of this system is in the use of the rails for conducting the controlling current of electricity. The essential apparatus consists of the signal and relay, shown in Figs. 1 and 2, and the ordinary type of "gravity" battery, from two to eight jars being used upon sections up to two miles in length. In order to diminish the resistance to the passage of the current, the rail joints are bounded by wire and plug as shown in Fig. 4, while the block circuits are electrically insulated from each other by wooden splice bars and fibre and posts or by fibre placed between the angle bar and rail, with fibre end posts and bushings as shown in Figs. 3 and 5. The wooden bar, although not so rigid, is preferable to the fibre as it lasts much longer and is less expensive to install and maintain. For making and breaking either the



FIGS. 3, 4 AND 5.—RAIL JOINTS AND CIRCUITS.

controlling or operating circuits the relay above referred to is used. By reason of the many improvements in the design and construction of this instrument, the perfected relay and its related parts being shown in Fig. 2, it is now possible for the Hall Signal Company to successfully operate under any track conditions which may be met within actual practice. This apparatus has shown itself to be perfectly reliable under extremely unfavorable conditions of weather, ballast, length of section, etc., without appreciable variation from its operation under favorable conditions.

In the system, as installed upon the D., L. & W. R. R., the signals stand normally at danger and are cleared by an approaching train upon entering the preceding block. The signal is again put to danger when the train reaches a point directly opposite the signal it has cleared.

The signal circuit cannot again be restored until the last car has left the section of the track in the block. Let us suppose that our train has reached a point within a block known as No. 10, and that another train is following and has arrived in No. 9, the preceding block. With

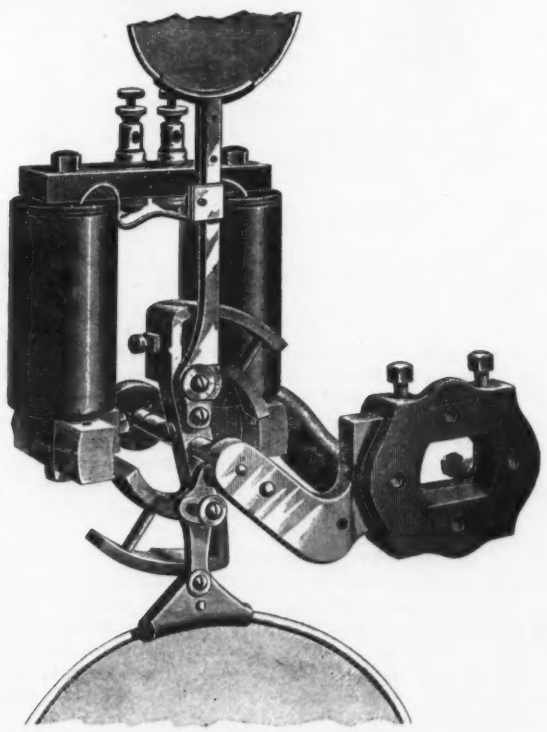


FIG. 8.—THE SIGNAL MECHANISM IN DETAIL.

a clear track in block 10, the signal at the entrance of block 10 would be drawn from "Danger" to "Clear," but this circuit being controlled by the train within the block, no current can pass and the signal remains at danger. This would also be the condition of the signal if its circuit became disarranged, and it is this feature that makes the system so eminently successful, the "clear track," or "Safe Signal" being dependent upon the flow of the electric current, while the "Danger Signal" is dependent only upon gravity, which is always the same regardless of place or weather conditions.

In Fig. 1 is shown the interior of the signal case, the left hand por-

tion showing the "Danger" position of the signal, which is, as above stated, dependent upon gravity, and at the right hand, the signal is at "Clear," which is dependent upon electro-magnetism.

Fig. 6 shows the mechanism in detail, consisting of two magnets and revolving armature, to which is connected the arms carrying the red discs, the lower one being for the day and the upper one for the night signal. A sectional view of the switch instrument is shown in Fig. 7. Normally, the contact point of the spring is closed and to open the switch is the equivalent of placing a train upon the track at that point. Another feature of this system is the fact that the battery is in use only a small portion of the time, thus rendering it the cheapest system to maintain. In the location of automatic signals the prime consideration is to so space the several blocks that the heaviest traffic likely to be had on the blocked track may be handled without interruption on account of the block being too long. In order to do this a thorough investigation is made into the condition of train service, alignment, grades, switching points, stations, water tanks, etc. After securing this information the signals are so located that, with unequal space intervals, the time ordinarily required to pass through the several blocks will be fairly equal. Thus, at stations, where a train generally stops, or on heavy up grades, blocks should be shorter than on the open road or down grades.

Signals are also located sufficiently far in advance to give an engineer ample time to stop after seeing the signal at "Danger."

As to the efficiency of this apparatus it may be well to quote from the 23d annual report of the Railroad and Warehouse Commission of Illinois. "The importance of safety devices for the protection of trains against collisions was very forcibly impressed upon us by our examination of one of the block signal systems in operation in the State. On the 7th day of September we accepted an invitation from Mr. J. F. Wallace, Chief Engineer of the Illinois Central, to inspect the actual workings of the Hall signal system in use by that company from their depot

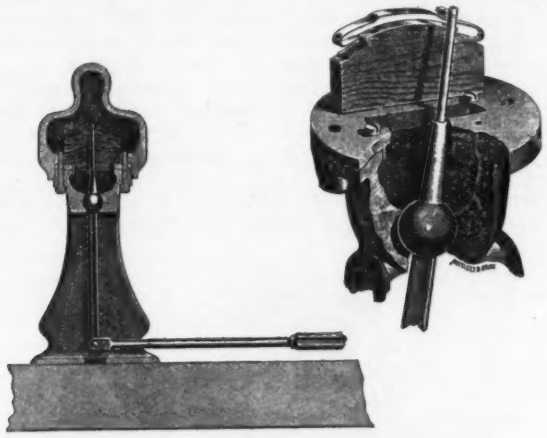


Fig. 7.—Section View of Switch Apparatus.

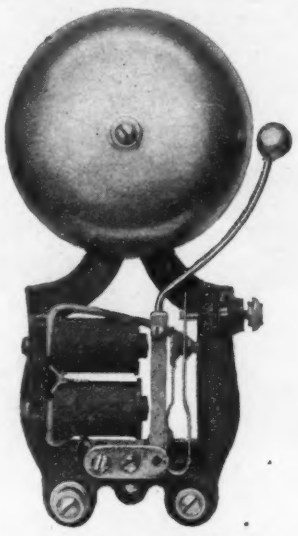
at Twelfth street to Kensington, a distance of about 16 miles, known as the terminal district of the Illinois Central. The examination was made during the very heaviest of the World's Fair traffic, and we deem it proper to say that in our general examination of the automatic and manual block signal systems for preventing accidents and protecting life and property on railroads, it is our opinion that the Hall system is among the best. One of the very important adjuncts of this excellent device is that while it apparently covers all the conditions of safety, its reasonable cost of installation and maintenance brings it within easy reach of many of the railroads, and reference to the report of our consulting engineers, found in this volume, will show the roads which have adopted block systems and the number of miles of each road protected by them.

"We are informed by the management of the Illinois Central that not a single accident occurred on that part of their line protected by the block signals, during their World's Fair traffic, which could in any way be attributed to defects in the block system; the average number of daily trains handled was between 700 and 800, and the number of passengers carried during the period of the Fair was 9,600,000, exclusive of through passenger business. This, in our mind, is proof conclusive that the block system in use on the road is a success."

The total number of passengers carried by the Illinois Central Railroad in the terminal district under protection of the Hall system was over 19,000,000 in the six months during the Fair.

Bug-proof Electric Bell.

The electric bell we illustrate, manufactured under the Varley patents, and which the Central Electric Company, 173 Adams street, Chicago, makes one of its specialties, ingeniously provides for a serious defect in ordinary bells from the destruction of contacts by bugs. In the Varley bell this vulnerable point has been ingeniously protected by a small elastic covering that completely encloses the solid platinum contacts, but does not in the least restrict the free vibration of the clapper. The bell being, otherwise, of the open frame construction, there are no inviting nooks where bugs will gather. The magnets are duplex wound and so arranged that the armature gets the full benefit of the "pull," and

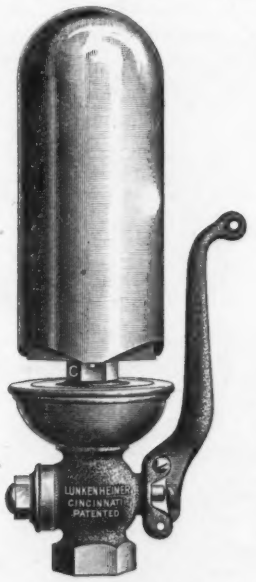


Improved Bell.

can be operated with much less battery than needed with an ordinary bell.

Single Bell Chime Whistle.

The style of single bell chime whistle, manufactured by the Lunkenheimer Company of Cincinnati, Ohio, which we illustrate, is handsome in appearance and produces harmoniously three distinct tones, which blend and form an agreeable musical chord. The sounds given forth from this chime whistle, while being more acute and piercing than the



Chime Whistle.

common whistle, have not the harsh and disagreeable qualities of the latter and can be heard at a greater distance. Another advantage of this style of construction is that the bell may be raised or lowered to suit varying pressures. To adjust the bell, the jam-nut C is loosened and the bell screwed up or down, until the whistle blows as desired.

The Electrician's Paradise.

According to the London "Electrician," the only European in Korea not paid by the Customs, who gets his pay regularly, is the electrician at the Palace. The King and all at his Court are so afraid of ghosts that they stay up all night. There are sorcerers—and the electric light also—to keep off the ghosts; if the electrician's pay falls into arrears the electric light apparatus breaks down and cannot be repaired until he is paid up.

Telegraphy in the United States.

According to some statistics recently published in a European journal it appears that there are more miles of telegraph lines in America than in all the rest of the world, and that there are a few thousand more miles in the United States alone than in the whole of Europe.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 22, 1894.

GENERAL ELECTRIC'S quotations express the present state of affairs emphatically. The people who have been trying to create some sort of public interest in the stock have given up the task for the present and have left the stock to take care of itself, until the value of the stock will appreciate naturally by reason of the increased business it is now doing. As a result of this neglect by both professional traders and investors, there is an utter dearth of news regarding the General Electric Company's affairs. It is known that a big business is being done, but no definite news of new contracts or new plans of administration are announced. Nor does one hear anything relative to the oft-discussed plan for readjusting the company's capital so as to make it agree with the diminished value of its assets. The committee in charge of the matter has held no meeting of late; one of its members, however, says now that the summer dullness is past, that steps will soon be taken to remedy the company's trouble. There is some justification for the report that the committee has during all the months since April, when it was authorized to devise some plan to make good the impairment of capital, purposely delayed action on the matter for the reason that they were then confident of the early return of better times, when the assets must greatly appreciate.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has declared its quarterly dividend of 1¼ per cent. on the preferred stock, payable on October 1 next, but has again disappointed common stock holders by letting the occasion for declaring a dividend on their stock again slip without letting them participate in the distribution of profits. The management admits that a dividend—and even more than the amount necessary was acquired—was earned on the common stock, but it is still adhering to the policy announced this summer of withholding any share of the profits from common stockholders, till it had provided for all the many improvements it has on hand and in contemplation, when the acquisition of big profits for distribution among the patient holders of the company's common stock will be an easy matter. The company is anxiously waiting, however, to get into the new works at Brinton, near Pittsburg, where the new machinery now being set up will turn out contracts on the most economical basis possible. It was thought that everything would have been ready by now, but the labor troubles of the summer delayed matters, and it will be some weeks yet ere everything is in readiness for removal. As it is, the main building of the new Brinton works is now finished. It was used recently as a convention hall during the encampment of the Grand Army of the Republic at Pittsburg. Its size made it particularly available for the purpose in question. The building is 750 by 410 feet, and, as it is to be chock-full of machinery, it is easily understood why it will take some time to fill this mammoth building with all the machinery that can be set up therein.

FORT WAYNE ELECTRIC—The old stock is slightly higher. The new Fort Wayne corporation is out with a circular urging the shareholders of the old Electric Company to serve their own interests by depositing by October 1 their stock under the plan announced some two months ago. In explaining the new bond issue to be made under the plan, the management of the Fort Wayne Electric Corporation announce that they will be offered at 90, payable 10 per cent. in cash on subscription on or before October 1; 40 per cent. in cash on or before October 31, and 50 per cent. on or before November 20, either in cash or in Fort Wayne Electric Company's stock at $5, or in both stock and cash. It is not announced whether the sucess of the bond issue is guaranteed by an under. writing syndicate.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, has declared its regular quarterly dividend of 1½ per cent., payable November 1, to stockholders of record on October 18. The stock has been rather strong since the publication of the good earnings noted in these columns last week, while there has been a noticeable investment inquiry after the bonds.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	10	30
Cleveland General Electric	100	80	90
Detroit Electrical Works	10	3	4
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	99	101
" " " Brooklyn	100	102⅝	103
" " " Boston	100	120	121
" " " Chicago	100	135	145
" " " Philadelphia	100	122	124
Edison Electric Light of Europe	100	1	3
Edison Ore Milling	100	10	15
Electric Construction & Supply Co., com.	15	7½	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2⅞	3
General Electric	100	38½	38¾
General Electric pref	—	70	72
Interior Conduit & Ins. Co.	100	35	45
Mount Morris Electric	100	25	50
Westinghouse Consolidated, com.	50	34	35
* " " " pref	50	51	52⅛

BONDS.

*Edison Electric Ill., New York	1,000	107⅛	108
Edison Electric Light of Europe	194	75	85
General Electric Co., deb. 5's	1,000	94	95

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	203	204
American District Telegraph	100	40	45
American Telegraph & Cable	100	90½	91
Central & South American Telegraph	100	105	110
*Commercial Cables	100	125	145
Erie Telephone	—	50	50⅝
Gold & Stock Telegraph	100	100	103
Mexican Telegraph	100	185	200
New England Telephone	—	68	69
*Western Union Telegraph	100	89⅛	89½

*Ex-div.

AMERICAN BELL TELEPHONE matters promise interesting developments at an early date. Ever since the failure of the company's endeavor in Massachusetts to issue $30,000,000 new capital stock in any way but at public auction, there has been no lack of rumors that the company would remove its headquarters to either New York or New Jersy, where more freedom was allowed corporations. A great deal of importance, therefore, is attached to the fact that there was incorporated at Albany this week the "Standard Telegraph and Telephone Company," with a nominal capital of $50,000, to "buy, lease or operate telephone systems." In the first place the list of incorporators and promoters contains many names of gentlemen interested more or less in the Erie and other companies subordinate to the Bell Company. Then the capital can, under the charter, be enlarged to any extent, as occasion shall suggest. Again, in speaking of the new company's plans, a director says that the Bell patents will be used under arrangements with the parent company. Putting all this together, it is openly asserted by many people that this is the first move preparatory to a change in headquarters. That the new Standard Company, with its unlimited potential capital, will build the lines to the west that the Bell Company proposed with its $30,000,000 new capital, and that the two companies will be so closely identified as to form practically one corporation. In fact, an actual consolidation, with offices in New York City, is declared to be one of the main features of the scheme. The directors of the new company are: Abner C. Adams, Charles J. Glidden, Francis Jewett, James H. Mills, J. W. C. Pickering and Asa C. Russell, of Lowell, Mass.; A. Page Smith and Arthur L. Andrews, of Albany, N. Y.; Jesse N. Truee, of Tewkesbury, Mass.; Charles P. Cummings and Wesley A. Gore, of Boston, Mass.

NEW INCORPORATIONS.

THE NATIONAL ELECTRO-CHEMICAL REDUCTION COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated by W. R. Omohundro, G. E. Plumb and C. E. Ridpath.

THE BALTIMORE, MIDDLE RIVER AND SPARROWS POINT ELECTRIC RAILWAY COMPANY, Baltimore, Md., capital stock $400,000, has been incorporated James Young may be addressed for information.

THE TERRE HAUTE AND BRAZIL ELECTRIC RAILWAY COMPANY, Brazil, Ind., capital stock $100,000, has been formed to construct a line 12½ miles in length. The incorporators are W. H. White, J. G. Elder and others.

THE BLUFF CITY ELECTRIC RAILWAY COMPANY, Waukegan, Ill., capital stock $200,000, has been formed to construct an electric railway in South Waukegan. The incorporators are S. D. Talcott, D. L. Jones, and others.

THE SOUTHERN HARRISON TELEPHONE COMPANY, Alexandria, Va., capital stock $100,000, has been incorporated, with S. W. Tulloh as president, W. H. B. Stout, vice-president, and S. H. Merrill as secretary and treasurer.

THE INTERSTATE TELEPHONE COMPANY, Louisville, Ky., capital stock $2,000, has been formed to operate telegraph and telphone lines, and electric light and power plants. T. G. H. Vance, G. L. Hogan and F. A. Vance are interested.

THE AMERICAN ELECTRIC EXERCISING MACHINE COMPANY, Chicago, Ill., capital stock $50,000, has been formed to manufacture and sell electric exercising machines. Jas. W. Williams, H. J. Weld and W. R. Bullion are the incorporators.

HILLSBORO LIGHT AND FUEL COMPANY, Hillsboro, O., capital stock $20,000, has been formed to manufacture and furnish electricity and gas, for light power, etc. J. R. Cook, E. W. Boxby, H. H. Campbell, Charles Horn and C. H. Moore are interested.

THE HIGHLAND PARK AND BUTLER STREET RAILWAY COMPANY, Pittsburgh, Pa., capital stock $12,000, has been formed to erect and maintain an electric railway. H. S. Stewart, J. J. Donnell and J. G. Holmes, all of Pittsburgh, are interested.

THE NORTHWEST GAS AND ELECTRIC COMPANY, Washington, Ia., capital stock $250,000, has been formed to own and operate gas works. A. E. Johnson, Liberty, Ind., G.W. Benedict, A.W. Snyder and S. C. Green, Washington, Pa., are interested.

THE PATERSON ELECTRIC CONDUIT RAILWAY CONSTRUCTION COMPANY, Milwaukee, Wis., capital stock $500,000, has been formed to manage and operate a conduit system for street and other railways, mills, etc. A. E. Smith, W. Meyst and H. S. Esch are the incorporators.

THE SCRANTON ELECTRIC CONSTRUCTION COMPANY, Scranton, Pa., capital stock $15,000, has been formed to build electric and other plants for electric lighting or power purposes, drilling, pumping, etc. The promoters are F. J. Platt, F. K. Platt and E. B. Sturges, Scranton, Pa.

THE NORTHERN ELECTRIC PASSENGER RAILWAY COMPANY, Harrisburg, Pa., capital stock $100,000, has been formed. The incorporators are A. C. Milliken, Pottsville; Charles H. Davis, S. S. Evans, G. L. Martin, N. A. Waldron, Philadelphia, and W. P. Perry, Langhorne.

THE KERLIN BROTHERS COMPANY, Toledo, O., capital stock $10,000, has been formed to contract for, build, construct and operate electric light and railway plants, gas plants, water works, etc. Richard Kerlin, E. M. Kerlin, W. A. Gashe, M. P. Murphy and P. Henahan are the promoters.

THE SIGNAL AND CONTROL COMPANY, New York, maximum capital stock $1,000,000, has been incorporated to manufacture and sell mechanical, electical and other apparatus. The promoters are N. Seymour, New York, H. B. Seymour, Flatbush, and J. H. De Revisse, Brooklyn, N. Y.

THE NEWCASTLE, MINERSVILLE AND TREMONT STREET RAILWAY COMPANY, Carlisle, Pa., capital stock $100,000, has been formed to construct, mainain and operate an electric railway. E. Davis, Broad Mountain, L. S. Sadler, and W. D. Sadler, Jr., of Carlisle, Pa., are the promoters.

THE EUCLID HEIGHTS COMPANY, Cleveland, O., capital stock $500,000, has been formed to construct and operate electric plants, electric and other railways, and also to build waterworks, etc. Pat Calhoun, R. R. Conklin, Wm. L. Rice, George A. Laughlin and A. J. Thompson are interested parties.

THE ROCKWELL CONSTRUCTION COMPANY, Paterson, N. J., capital stock $30,000, has been formed to build and repair electric works, railroads, etc. E. G. Wightman, Middletown, N. Y.; M. J. Wightman, B. H. Throop and W. B. Rockwell, Scranton, Pa., and J. C. Hinchcliffe, Paterson, N. J., are the organizers.

THE SCRANTON ELECTRIC CONSTRUCTION COMPANY has been incorporated with a capital of $15,000. Mr. Wm. T. Smith is president and Mr. F. J. Platt is the general manager. The objects of the company are to erect plants for the maufacture of lighting, drilling, hauling and mining machinery for the mines.

THE NEW JERSEY ELECTRIC RAILWAY COMPANY, Paterson, N. J., capital stock $2,000,000, has been formed to construct and operate a street railway. C. A. Johnson, Brooklyn, N. Y; G. V. Turner, New York; F. Irving, Jersey City, and J. McGuinness, Jr., Ridgewood, N. J., are among the interested parties

THE ELECTRIC SWITCH AND TROLLEY COMPANY, Newark, N. J., capital stock $500,000, has been formed to manufacture and sell electric and other switches, motors, cars and other improvements and appliances for railways. Emile Rieser, J. S. Campbell, New York, and G. W. Littell, Cranford, N. J., are interested.

THE LOS ANGELES GAS AND ELECTRIC MANUFACTURING COMPANY, Los Angeles, Cal., capital stock $50,000, has been formed to manufacture and deal in electrical fixtures, brass and iron ornamental work, etc. Those interested are M. Meyberg, Moritz Meyberg, S. Nordlinger, L. Uhfalder, L. Himmelstern, Los Angeles.

PORT CHESTER, RYE AND MAMARONECK ELECTRIC RAILWAY, COMPANY, Port Chester, N. Y., capital stock $150,000, has been formed to build and operate a surface road nine miles long. W. Ryan, H. M. Henderson, N. J. Sands, J. F. Mills, J. M. Sullivan, Port Chester; C. D. Haines, T. F. Woodworth, Port Chester, N. Y., are the incorporators.

THE NEW LONDON ELECTRIC LIGHT COMPANY, New London, Conn., capital stock $4,000, has been formed to generate and furnish electric light, power and heat. D. J. C. Arnold, H. G. Skinners, C. E. Reynolds, S. L. McCready, O. G. Carter, Jr., E. R. Stilson, J. H. Beattie, F. R. Hubbard, W. R, Brundage, R. B. Powers and J. T. Kelley are interested.

THE ZENITH GAS ENGINE AND POWER COMPANY, San Francisco, Cal. capital stock $1,000,000, has been formed to manufacture and sell electric, gas and vapor engines; to build and operate telegraph and telephone lines, also railways, plants, etc. The promoters are John W. Eisenhuth, L. F. Dunand, R. Herman, A. R. Herman and Sam F. Simrah, San Francisco, Cal.

THE CENTRAL OHIO ELECTRIC RAILWAY COMPANY, Mt. Vernon, O., capital stock $100,000, has been formed to construct and operate an electric railway between Pittsburg, Pa., and Chicago, Ill., and also to supply light, heat and power, to construct telephone and telegraph lines, etc. The promoters are G. A. Jones, F. W. Jones, J. A. Caldwell, Wm. M. Koons and M. Spellacy.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Sept. 24, 1894.

MR. EUGENE H. ABADIE, of the Wagner Electric Manufacturing Company, St. Louis, has been making quite an extended trip through the Eastern cities, and when in New York a few days ago called at the office of The Electrical World.

MR. THOMAS C. PERKINS, of the Mather Electric Company, of Manchester, Conn., made a flying trip to New York last week. Mr. Perkins finds business very brisk, the Mather Company having enough orders on hand to keep it busy for the next three months.

A CORRECTION.—In a note in this department in our issue of last week, Mr. Henry B. Oakman, by a printer's error, was stated to be general Eastern sales agent of the Western Electric Company, instead of the Wenstrom Electric Company.

PETER B. SWEENY, a former member of the Tweed regime, has an article occupying all of the first, and part of the second, page of the New York Sun of September 24, attacking the recent New York Rapid Transit Act. It is argued that the act is unconstitutional, and the adoption is advocated of a system of rapid transit provided for by a former legislative grant, which places the necessary power in the hands of the Governor, Mayor and Commissioner of Public Works.

WARREN & LOZIER, mechanical and electrical engineers, 465 Greenwich street, New York, have succeeded to the business of the New York Electrical Repair Company. Enlarged premises and equipment, together with a carefully selected force, enable them to undertake repairs of all kinds, both electrical and mechanical, to electrical machinery, the building of standard, special and experimental electrical apparatus, the erection of generators, motors and engines, and the construction of switchboards of all kinds. Dynamo and motor supplies of every variety will be kept in stock.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
September 22, 1894.

CIFFORD L. SNOWDEN, for the past three years assistant editor of the "Street Railway Review," has resigned to prosecute post graduate work.

THE ROYAL ELECTRIC COMPANY, the well-known Peoria, Ill., firm, is enjoying a season of unusual prosperity, as its apparatus is meeting with much favor wherever introduced.

THE DIAMOND ELECTRIC COMPANY, of Peoria, Ill., will shortly place on the market a new watt meter that promises to be a very good thing. They are now busy manufacturing transformers, on which their enviable reputation was founded.

D. FRED SWEET, inventor of the Sweet limit switch now being manufactured in Grand Rapids, Mich., was a Chicago visitor during the week. Mr. Sweet has a new and greatly improved switch that he is about ready to offer the electrical public.

THE JENNEY ELECTRIC MOTOR COMPANY, of Indianapolis, Ind., has closed an order with the W. S. Tyler Wire Works, of Cleveland, for 60 one-third-h. p. special motors, to be directly connected to wire looms. This is an important order, marking, as it does, a decided advance in the introduction of electric motors in manufacturing establishments. The competition was very warm, but the Jenney motor seemed to get there.

Canadian Notes.

OTTAWA, Sept. 20, 1894.

WINNIPEG.—The electric street railway is to be extended to Armstrong Point.

HULL, QUE.—From appearances the inauguration of an electric light system in Hull will take place at an early date. The matter is now assuming a definite shape.

MONTREAL.—The Holmes Electric Protection Company for Canada has issued bonds in the amount of $75,000, bearing interest at 5 per cent. per annum, having twenty years to run.

TORONTO.—The City Treasurer has received a check for $7,013, being 8 per cent. of the street railway earnings of $87,660 for the month of August. Last year in August the earnings were $89,436, the excess of last year over this being attributed to the military tournament during August.

TORONTO.—Application for a charter has been made to the Ontario government by the Electric Chronometer Company, for the purpose of manufacturing chronometers and other time indicators, supplying by electric means correct time from central clocks, etc. The capital stock to be $100,000.

NEW WESTMINSTER, B. C.—Notice is given that the Westminster Vancouver Tramway Company is for sale, and that tenders will be received up to November 24. The lines extend throughout the city of New Westminster, in the province of British Columbia, and between that city and the city of Vancouver.

HAMILTON, ONT.—The Cataract Power Company, with a capital stock of $100,000, is applying for a charter for the purpose of carrying on a business of an Electric Power Company in all its branches. The operations of the company are to be carried on in the city of Hamilton and the town of Niagara Falls.

OTTAWA.—A charter has been granted incorporating the Packard Electric Company, with a capital of $300,000. The directors are: William Packard and James Packard, of Warren, Ohio, electricians; John Howry and Henry Howry, of Saginaw, Mich., lumbermen; Charles Paige, of Montreal, business manager; Frederick Cavanagh, electrician; Alexander Mackenzie, of Toronto, barrister; and Thomas C. Sims, of Little Current, Ont.

English Notes.

(From our own Correspondent.)

LONDON, September 15, 1884.

AN EXHIBITION OF ELECTRIC MOTORS.—The exhibition of electrically driven machine tools, which was announced some time ago to be held at Budapest, has resulted in the getting together of 32 alternate current and 42 continuous current motors, driving drills, lathes, printing presses, ventilating fans, saws, sewing machines, etc.

THE ELECTRIC CONSTRUCTION COMPANY.—This concern, which is one of the first three leading manufacturing companies, and which was founded by Mr. Thomas Parker, who was responsible for the electrical equipment of the Liverpool Overhead Railway, has apparently, under the auspices of Mr. Emile Garcke, who saved the Brush Company from wreck some years ago, commenced an era of retrenchment and reform. As I have already stated, there has been a wholesale reduction of staff, the reduction including Mr. Parker himself, and now instead of as heretofore paying dividends, about the earnings of which doubt existed, the company has devoted what profit it has been able to make to the reduction ot its liabilities.

SAYER'S ARMATURE.—The largest dynamos yet built on the principle enunciated by Mr. Sayers before the Institution of Electrical Engineers last summer, is one of 80-kilowatt output, which has just been completed for a Russian factory. Mr. Sayer's device consists in nterposing between each main armature coil and its appropriate commutator section a small auxiliary coil, which he carries backwards along the armature relatively to the main coil connected with it, so that when the main coil is passing under the brush its auxiliary coil is actively cutting lines of force and generating sufficient E. M. F. to enable the current in the main coil, just passing under the brush, to reverse sparklessly. The subsidiary advantage of this device is that it enables the series coils to be dispensed with, since the demagnetising coils usually existing on armatures are no longer existant when Mr. Sayers' device is applied to it, since the brushes need have no lead. At the time this device was described, there was a general consensus of opinion that it marked a most important advance in dynamo design.

News of the Week.

Telegraph and Telephone.

DURHAM, N. C.—L. A. Carr and E. G. Linebury are reported to be constructing a telephone line and exchange.

THE CITIZENS' TELEPHONE COMPANY, Raleigh, N. C., has been incorporated by A. R. D. Johnson and others.

CALVERT, TEX.—S. S. Mayo and J. D. Atkinson representing a Chicago company, have closed a contract to establised a telephone exchange in Calvert.

CLINTON, IOWA.—A new telephone company has been organized, which, to start, with will have 300 guaranteed subscribers signed for five years. The following are the officers: P. S. Towle, president; A. Lamb, secretary and treas-

urer. No system has been adopted, but the officials would like to hear from all telephone makers.

MASON, O.—The Warren County Telephone Company, Ohio, M. Blake, R. M. Van Herlingen, W. N. Cox, Wikoff and J. M. Van Dyke, propose to erect and operate a telephone line between the Indiana state line and the eastern line of Greene and Clinton counties and through the eastern counties of Warren, Butler, Montgomery, Hamilton, Greene, Clermont and Clinton.

CINCINNATI, O.—The Board of Administration has granted to the Western Union Telegraph Company a franchise for laying conduits for its wires throughout the city. It will require 700 miles of lines to complete the new service.

ALEXANDRIA, VA.—A charter has been granted by Judge Keith of the Circuit Court to the Southern Harrison Telephone Company, to do general telephone business in Virginia and other Southern States. Capital stock $100,000. W. H. S. W. Tolloh, President; W. H. B. Stout, vice-president; S. H. Merrill, secretary and treasurer, and Warren Choate, general manager.

TELEPHONE COMPANIES.—The most complete list of telephone companies in America is given in the new edition, just issued, of Johnston's Electrical and Street Railway Directory, an announcement of which appears in another column. This list includes not only all the local companies operating under the American Bell patent, but also companies that have recently been established to introduce other 'phones.

ELECTRIC LIGHT AND POWER.

FREDONIA, N. Y.—The town of Fredonia will be lighted by electricity.

HEMPSTEAD, N. Y.—Address the Town Clerk regarding the contract for electric lights.

BALLARD, WASH.—The town has voted to issue $6,600 in bonds for an electric light plant.

CUTHBERT, GA.—An electric light plant is to be established at Cuthbert at a cost of $50,000.

UNION CITY, MICH.—The citizens voted September 11 to issue $25,000 water and light bonds.

FLORENCE, ALA.—The Cherry Cotton Mills are about to install an isolated incandescent plant.

LUDLOW, KY.—The Council ordered bids to be received September 27 for lighting the city by electricity.

TOLEDO, O.—An ordinance has been passed to improve Warren and Bancroft streets by electric lighting.

STEPHENVILLE, TENN.—Address the city clerk concerning a new electric light plant to be established by the city.

BRIGHTWOOD, IND.—The Brightwood Commercial Club is discussing means of establishing a municipal lighting plant.

DUNELLEN, N. Y.—A meeting of the residents is announced to organize an electric light and water supply company.

GREENVILLE, TEXAS.—The capacity of the Greenville electric light plant, which is owned by the city, is to be doubled.

ALEXANDRIA, VA.—The Court has confirmed the sale of the Potomac Electric Light Company's proprety to A. H. Wiley.

SPRINGFIELD, MO.—The City Clerk was instructed to again advertise for bids for city lighting, to be opened October 15.

COLUMBIANA, O.—The proposition to bond the town for $8,000 for an electric light plant was carried with practically no opposition.

STILLWATER, MINN.—Address J. F. Burke, city clerk, concerning furnshing the city with 15 arc lights and 263 incandescent lights.

TOLEDO, O.—The city electrician and solicitor have prepared plans and specifications and will soon advertise for bids for city lighting.

TREMONT, PA.—The Electric Light & Power Company has purchased the Heil property on Crescent street and will erect its power-house there.

VICKSBURG, MISS.—The proposition for the city to build and run the electric light service as a part of the city is meeting with almost universal favor.

ATTLEBORO, MASS.—At a special town meeting held it was voted to appropriate $4,875 for lighting the streets, the new power-house to furnish the power.

PONTIAC, MICH.—The City Council has awarded the contract for lighting the city for five years to the Commercial Electric Lighting Company, of Detroit, at $60 for each 2,000-c. p.

RIVERSIDE, O.—An election will be held October 15 to vote on the question of issuing $50,000 in bonds for electric light and water works. Roger Wright is Mayor.

OMAHA, NEB.—At a meeting of the Council an ordinance to submit a proposition at the next election for the issue of $200,000 bonds to erect an electric lighting plant was read and referred.

ROCKWOOD, PA.—Electric light is said to be in sight for Rockwood, a company having been organized with this object in view.

NEW BRITAIN, CONN.—The Young Men's T. A. B. Society of this city is going to erect a new building of its own. It is calculated to light the building by electricity and to heat it by means of furnaces.

PATERSON, N. J.—The plans for the new central station for the Edison Electrical Illuminating Company are so far advanced that the proposals for excavation, etc., will be advertised for in a few days.

KALAMAZOO, MICH.—An injunction was served on the Council to prevent the contract for the erection of a municipal electric light plant that has been under discussion for the last year. Illegality is alleged.

DAYTON, O.—The School Board is discussing the advisability of equipping the new high school with machinery for the purpose of producing its own lights and providing power for the manual training school.

MILLBROOK, ONT.—An agent of the Canadian General Electric Company has succeeded in securing the right-of-way on the streets and the promise of the council to consider the lighting of some of the streets by electricity.

KEWANEE, ILL.—On motion the Clerk was authorized to advertise for bids for 35 electric lights of 16-candle power each, and 100 gas lights of 16-candle-power each, said lighting to run for one year from October 1, as per moonlight schedule.

DAYTON, O.—The Board of Trade is considering the matter of cheaper electric lighting. The franchise of the Dayton Electric Light Company is by the year and does not extend through a term of years. The committee recommended the erection of a municipal plant.

JACKSONVILLE, FLA.—The General Electric Company has been awarded the contract for the city lighting plant. The apparatus contracted for includes two 120 kw monocyclic alternators, four 60-lt. Brush arc dynamos, with lamps, line wire and supplies, and complete steam plant.

COVINGTON, KY.—The directors of the Covington Electric Light Company have decided to increase the size of the plant. Two additional dynamos are to be placed in the power-house, with a capacity to light all of Covington, Ludlow Newport, Bellevue and Dayton, and all of Covington's suburbs.

FLORENCE, COL.—At a special election called for that purpose a franchise was granted to the Arkansas Valley Electric Company to erect an electric light plant for this city. The vote was almost unanimous. It is expected that work will be started upon this plant in fifteen days and that it will be running in sixty days.

KENSINGTON, PA.—The preliminaries are in progress for the erection of an electric light plant at Kensington. An ordinance will be presented at the next meeting of the Town Council for the franchises. The projectors are Messrs. Sidney Fuller and F. N. McKee, of Dubois; Capt. B. W. Weyman, of Tarentum; W. H. H. Piper, of Kittanning, and others.

JACKSON, TENN.—S. C. Lancaster, city engineer, may be addressed concerning a contract for 40 double arc, 2,000-c. p. lamps, with the privilege of 50, at the same price per light, for a term of five years. The city will grant an exclusive franchise for all arc and incandescent lighting, for both commercial and domestic use, for the same length of time.

PENSACOLA, FLA.—At a meeting of the directors of the Citizens' Electric Light & Power Company it was decided to purchase the Hudson property, between Paloford and Main streets, as a location for their plant. It was also decided to begin operations at once, and an order for the machiney will be given as soon as the details are decided upon, which will be at an early date.

CROSSDALE, ILL.—Willis Mellville Paine Harrington, Oscar E. Taylor, Werner Martin and Max Rathberger, of Crossdale, have organized a corporation to build water-works and an electirc light plant. The capital stock is $500,000. The business will be conducted on the cooperative plan. The electric light plant, to cost $10,000 and to serve a territory two miles square, will be commenced in three weeks.

CENTRAL ELECTRIC LIGHTING STATIONS are increasing in number in this country. The new edition of Johnston's Electrica and Street Railway Directory, an announcement of which appears in this number, contains a list of 2,344 electric light central stations with a paid in capital of $277,437,113. These are located as follows: United States, 2.124; Canada, 172; Mexico, 41; and Cuba, 7. The directory also gives a list of 7,475 isolated plants and 271 mining plants.

SPOKANE, WASH.—Councilman Clay has prepared a resolution calling for plans and estimates from the city engineer for the enlargement of the power-house at the new water-works. Mr. Clay says the power-house, as now designed, will not be large enough for the dynamos and other machinery for the proposed electric light plant to be built by the city. He thinks a majority of the council will favor the resolution. He estimates that it will cost the city $75,000 to put in the plant and erect its own wires and lights.

THE ELECTRIC RAILWAY.

HAMILTON, ONT.—The H. & D. Railway will soon adopt electricity as a motive power.

DANBURY, CONN.—Frederick Wardwell, who is to build the trolley road, has broken ground for the road bed.

CHARLOTTESVILLE, VA.—J. E. Moore has been awarded the contract for constructing the Charlottesville electric road.

HARTFORD, CONN.—The Hartford Street Railway Company will build a power-house on the east side of Commerce street, the building to be one-story high and 131 by 65 feet.

GETTYSBURG, PA.—The power-house of the Electric Light and Railway Company has been burned. The loss was $65,000 with no insurance. The plant was owned by a private company.

COLLINSVILLE, ILL.—An ordinance has been prepared granting right-of-way for an electric road to East St. Louis. Dwight Treadway is interested in the construction of the road.

SAGINAW, MICH.—The Union Street Railway Company will extend its lines to Carrollton and Milwaukee. Franchises have been granted by both towns. Work will be commenced at once.

LEWISTON, N. Y.—It is announced that an effort is to be made to revive the project of building an electric railroad along the waters' edge of the Niagara river from the state reservation to Lewiston.

SCRANTON, PA.—Work on the new extension of the South Side Street Railway was begun on Hickory street and will be continued until the end is reached, which will be within three months.

RUTLAND, VT.—A petition of the City Electric Street Railway Company, asking for a permit to construct an electric street railway through various streets in the city, was read. The petition was not acted upon.

BRAINTREE, MASS.—It is expected that a franchise will be granted to the directors of the Braintree & Weymouth Electric Street Railway Company for the construction of its line between Braintree and Weymouth.

WALLINGFORD, CONN.—Henry B. Todd is circulating a petition to the officers of the Meridan Railroad Company, asking them to build the road through Main street to the new cemetery. It meets with general favor.

PITTSBURG, PA.—The McKeesport & Reynoldton Company has completed a deal with the Dravosburg & Homestead Railroad, and an electric railway is to be built connecting McKeesport and Pittsburg via the Second avenue line.

MANCHESTER, O—The proposed electric road between Manchester and

West Union will be commenced within three weeks. Frank E. Holliday, of Ironton, the promoter of the line, is securing the right-of-way.

CALDWELL, N. J.—An injunction has been issued restraining the Council and Mayor from any further action in the matter of granting a franchise to the North Jersey Traction Company, the hearing to take place October 1.

WASHINGTON, D. C.—The Washington-Great Falls Railway Company, offices at 1420 F street, will equip its lines with electric motors. J. P. Clark may be addressed for further particulars. The road is to be seven miles long.

NETHERWOOD, N. J.—Mr. Spangenberg, of Netherwood, who has been hard at work trying to get the street railway to extend to Netherwood, is in a fair way to succeed. Adrian Riker, Newark, N. J., can probably give information.

POTTSVILLE, PA.—The Town Council has granted permisison to the Schuylkill Electric Railway to construct and lay one single track, with turnouts, and operate the same. R. S. Chrisman is President of Town Council and H. R. Nichols is Chief Burgess.

PHILADELPHIA, PA.—An ordinance was presented by Mr Huey, by request, permitting the Philadelphia & Ardmore Passenger Railway Company to lay its tracks, erect poles, etc., for the purpose of using electricity as a motive power on its cars.

PORT CARBON, PA.—A franchise has been granted by the Town Council to the Tamaqua & Pottsville Electric Railroad for permission to construct and operate an electric railroad on certain streets in Port Carbon. Robert Allison is president of the council.

BOSTON, Mass.—The Committee on Streets and Sewers will meet and give a public hearing on the petition of the Newtonville & Watertown Street Railway Company for the right to enter the city via North Beacon street, Brighton avenue and Commonwealth avenue.

FORT WORTH, TEX.—The Polytechnic Street Railway has been purchased by R. Vickery, S. S. Ashe and others. A new company will be formed under the title of the Glenwood and Polytechnic Street Railroad Company, and the line extended and rolling stock added.

SOUTH ORANGE, N. J.—A petition has been presented at the meeting of the South Orange Village Board of Trustees, from the New York Standard Construction Company, asking for a franchise to operate an electric railway on certain srteets in the village. The matter was laid over.

NEWARK, N. J.—H. M. Marsh, representing the North Jersey Street Railway Company, made a canvass of Hilton and North Irvington, to secure signatures of property owners to a petition for a franchise. Mr. Marsh says that work on the line will begin just as soon as the franchise is secured.

BENWOOD, W. VA.—The contract for the building of the electric railway of the Benwood Southern Street Railway Company, extending from Fourth street in Benwood through the narrows to Moundsville, was granted to the firm of Wareham & Highes, of Beaver Falls, Pa.

IRONTON, O.—Heald & Holliday, of this city, closed a contract with the Frazier Highland Construction and Equipment Company, of Chicago, Ill., for the construction of a railway line between Manchester and Winchester, O., a distance of 25 miles, and to equip the same, for a consideration of $200,000.

BUCKFIELD, ME.—The matter is being agitated and discussed of putting in an electric road from Buckfield, which is on the Portland & Rumford Falls Railroad, through the village of North Buckfield, West Sumner, North Paris to West Paris, connecting with the Grand Trunk Railroad at the latter place.

MT. PLEASANT, PA.—Messrs. Frank and John Shephard, A. Shupe, of Mt. Pleasant, have asked of the Homestead Council the privileges of a franchise for the Mt. Pleasant Electric Light & Heating Company. This company proposes to build an immense plant and will furnish light for the East Homestead and Burns Station, Whittaker, etc.

PHILADELPHIA, PA.—The Northern Electric Passenger Railway Company has been incorporated, with a capital stock of $100.00, for the purpose of building a new trolley line which will run through the northren suburbs. Incorporators: A. C. Milliken, Pottsville; Chas. H. Davis, S. S. Evans, G. L. Martin, N. A. Waldron, Philadelphia, and others.

WALDEN, N. Y.—It is deemed possible that the electric railroad from Orange Lake to Walden will be built and completed within two months. William C. Weller and Isaiah W. Decker, who are well known and influential residents of Walden, say that a large majority of Walden people want to see the electric road extended to that place from Orange Lake.

MCKEESPORT, PA.—The McKeesport & Wilmerding Electric Railway has absorbed the Citizens' Railway Company by purchasing all its property, which will be joined to and with the Wilmerding road a new railway system covering the hill territory and a route to Brinton. It also proposes to extend the Jenny Lind street line down Fremont street.

MILLBURN, N. J.—At the meeting of the Millburn Township Committee Edwin W. Hine and J. H. Baldwin, of Orange, representing the New York & Philadelphia Traction Company, applied for a franchise for the construction of a trolley line in Millburn township. It is intended to connect the line with the Consolidated Traction Company's Irvington branch.

SOUTH ORANGE, N. J.—Chairman Becker, of the Railway Committee, made a report containing many suggestions concerning a franchise to be granted for the construction and operation of an electric passenger railway within the limits of South Orange township, on Springfield avenue, to the Central Jersey Traction Company. The committee favors a double track.

PEEKSKILL, N. Y.—A company is being formed in Peekskill to build and operate an electric trolley railroad through the principal streets of the village. The directors are Charles E. Hammond, Dr. J. N. Tilden, T. D. Husted, J. W. Westbrook, Henry E. B. Armstrong and others, of New York. They have already purchased property for a power-house and car-sheds.

POTTSVILLE, PA.—A meeting of the citizens of North Manheim Township was held at the Seven Star Hotel to consider the matter of giving up the center turnpike for an electric railway extension. The committee appointed are L. W. Weissinger, James Deibelt, John Gerber, Wellington Hartman, George Heffner and Fred Beck. Another meeting will soon be held.

ST. LOUIS, MO.—A petition was presented in the County Court by George R. Webster, of Webster Groves, on behalf of Charles Greenwood, Joseph M. Fitzrot and W. M. Pearce, consulting engineers of the Westinghouse Electric Supply Company, asking for a franchise to build an electric road from the city limits at Greenwood to Meramec Highlands. $150,000 have already been subscribed.

BOUND BROOK, N. J.—An ordinance has been introduced in Council to authorize and empower the New York & Philadelphia Traction Company, a corporation incorporated under the laws of the state of New Jersey, to locate, construct, operate and maintain a street railway through the borough of Bound Brook, Somerset County, New Jersey, to be operated by electricity or other motive power, except steam.

MATAWAN, N. J.—Two parties representing different companies have been here this week to secure right-of-way for electric railways from Matawan through Keyport, Leonard avenue, Atlantic Highlands, and Navesink to Red Bank. A number of citizens have agreed to give the privileges asked free of charge. One party represented a New York electrical company and another a Monmouth county concern.

NORWALK, CONN.—Engineer Hill, accompanied by President E. J. Hill and Secretary W. F. Acton, of the Norwalk Street Railway Company, have been inspecting property along the east side of the river with a view to determine the feasibility of a route down Smith street, thence along the shore, going under the Consolidated tracks at Fort Point street. It would then be a comparatively easy matter to reach Gregory's Point.

SAN FRANCISCO, CAL.—The Market Street Cable Railway Company has purchased the Eddy Street Electric line, and will have a five-cent fare to the Cliff House. This is done to head off Sutro's electric road. It will not effect him, however, as he will give free tickets to Cliff Heights and baths to those traveling by his line, while others will pay 10 cents admission. The Market Street line is controlled by the S. P. R. R. Co.

MOBILE, ALA.—Mr. S. C. Schaffner has resigned his position as electrical engineer of the Mobile Light & Railway Company to become electrical engineer and superintendent of the Electric Lighting, Gas Light & Coke Company. Mr. S. M. Coffin, formerly electrical engineer of the Twin City Rapid Transit Company, of St. Paul and Minneapolis, Minn., succeeded Mr. Schaffner in September with the first named company.

PHILADELPHIA, PA.—Plans were approved by the Building Inspectors for the power station to be erected at Twenty-fifth and South streets for the Electric Traction Company. The structure will be of stone, iron and copper, and will be built on driven piles. There are to be four engines and four boilers in the building, which, with the machinery, will cost about $225,000. Chas. McCall has the contract and will begin work at once.

NORTH TONAWANDA, N. Y.—About a year ago a company was formed to construct and operate an electric railroad between North Tonawanda, Sanborn and Pekin, the officers being F. W. Arend, Buffalo, president; vice-president, Leo P. Sanborn, etc. But it is understood that a deal is now under consideration with Trenton, N. J., parties for the purchase of the franchise and the right-of-way. If this is consummated it is most likely that the road will be built this year.

BLANFORD, MASS.—Great interest is taken in a proposed electric railway to go from Russell to Blanford. George A. Hill and W. H. Allis, of Springfield Mass., are promoting the project and propose to raise the $50,000 necessary to build and equip the road if Blanford people will make the preliminary surveys and give the right-of-way over private grounds. A meeting was held and the following committee appointed: Dr. W. H. Dean, Deacon Wm. Hinsdale, Geo. A. Hill, Walter Oatley, I. E. Cooney, W. H. Lewis, E. W. Boise.

PHILADELPHIA, PA.—The Council's Committee on Street Railways met and agreed to report favorably the ordinance granting the West Philadelphia Passenger Railway Company and the Philadelphia Traction Company the right to erect poles, lay tracks and use electricity on streets in the Thirty-fourth Ward, or further extension of the Twenty-second street and Allegheny avenue passenger railway, and giving permission to the Union Passenger Railway Company to lay a single track on Cumberland street from Sixteenth to Seventeenth streets.

PATERSON, N. J.—The certificates of incorporation of the New Jersey Electric Railway Company and of the New Jersey Construction Company were filed. The first company has a capital stock of $2,000,000, and of that amount $27,000 is stated as paid in to commence operations. Stockholders are Chas. A. Johnson, Brooklyn; Geo. V. Turner, 12 East 119th street, New York city, and others. The capital stock of the construction company is $27,000; the company will build electric railways and buy and sell lands for the purpose of erecting and promoting electric railways. Stockholders Geo. V. Turner, New York; Frank Irving, Jersey City; John McGuiness, Ridgewood, and others.

THE NUMBER OF MILES of street railways in operation in the United States on January 1, 1894, according to a report to the Permanent International Railway Union, contained in the issue of the "Elektrotechnische Zeitschrift," dated September 6, 1894, aggregated 12,001 miles, of which 7,470 were operated by electricity, 3,308 by horses, 658 by cable and 565 by steam. Johnston's Electical and Street Railway Directory, just issued, and an announcement of which appears in this issue, gives 965 street railways in the United States and Canada with a paid in capital of $648,330,755. Of these 606 are electric railways, in which the capital invested is $423,493,219; while 359 are operated by horses, steam or cable, and in these $224,837,536 is invested.

MISCELLANEOUS NOTES

THE ADAMS TROLLEY SUIT.—The case of Dr. Wellington Adams, who has been suing for infringement of patents alleged to apply to all street railways using electric motors, was dismissed in the Federal Court at St. Louis on September 17.

A MEXICAN INDUSTRIAL EXPOSITION.—The editor of "Dixie," a prominent Southern industrial journel, desires expressions of opinions from manufacturers as to the advisability of holding an exhibition in the city of Mexico of American manufactures.

MR. B. J. ARNOLD, in accordance with the preference expressed by a plurality of members in Chicago and vicinity, has been appointed by the Council of the American Institute of Electrical Engineers, as local honorary secretary for that city, to succeed Mr. Edward Caldwell, resigned on account of his removal to New York.

TRANSFORMER SUIT.—The Westinghouse Electric and Manufacturing Company has commenced a suit in equity against the General Electric Company, for alleged infringement of the Shallenberger patent on electrical converters held by the complainants. An injunction until the suit is tried and damages for back profits are asked for by the complainants.

A FRENCH EXPOSITION.—The French Consul General at New York noti-

fies us that the Societe Philomatique of Bordeaux has organized an exposition to be opened on May 1, 1895. It will be international for England, Belgium, Switzerland, Italy, Spain and Portugal, and universal in three sections, of which one is electricity, to which exhibits from all countries are invited. Consul General Thebaut will be very glad to furnish the necessary information to prospective exhibitors.

WESTERN SENSE AND EASTERN NONSENSE.—The St. Louis Republic has the following in a recent issue: In a recent issue of a New York paper a half page of presumably valuable space was devoted to an attack on the trolley car idea. A sensational writer went into spasms over a speed of sixteen miles an hour in the suburbs, employing the following humorously vague sentence: "Onward, with noise and dust, and the wild clangor of the alarm bell ringing out on the night air, we plunged ever forward." In the name of all the superb trolley cars of this city, that put us into our homes in half the time formerly employed, did this writer expect to plunge any way but forward? Did he want a reverse motion, or did he think that it is within the line of the motorman's duty to experiment with the aeroplane idea? Such sensational nonsense as this is ever to be found in the Eastern papers.

ELECTRICAL STATISTICS.—From the new edition of Johnston's Electrical and Street Railway Directory, an announcement of which appears in the advertising columns this week, it appears that there are 5,444 manufacturers, dealers, electricians, etc., mentioned in the directory. The names are arranged in three ways: Geographically, according to cities and towns; alphabetically, according to the names of the dealers, etc., and finally according to the business in which they are engaged. The directory also includes a list of 2,344 electric light central stations, 7,475 isolated plants and 271 mining plants, prices paid for city lighting, lists of street railways, telegraph companies, telephone companies, district messenger companies, etc.

PERSONAL NOTES.

MR. ALFRED E. WIENER was married at Schnectady, N. Y., on September 20, to Miss Lilia D. Benedict, of that city. After a brief trip the happy pair will make their home in Schnectady.

MR. G. E. DUNTON, formerly with E. C. Allen & Company, of Augusta, Me., has accepted a position with the Bureau of Engraving and Printing, United States Treasury Department, Washington. Mr. Dunton will take charge of the electroplating work, and it is probable that this branch of the department will be considerably developed in the near future.

Trade and Industrial Notes.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, 50 Broadway, New York, sends us a neat four-page card folder illustrating and describing the Fleming dynamo brush, and giving a list of the various sizes made, and of prices.

THE BROWN ELECTRIC AND MACHINERY COMPANY, of Little Rock, Ark., recently received a telegraphic order for two electric light plants to be installed in sugar refineries at Jeanerette, La. This makes ten electric plants this company has sold since August 1, and most of them have gone to Texas and Louisiana.

THE CORRESPONDENCE SCHOOL of Technology, Cleveland, O., has issued a little pamphlet containing 27 pages of "Hints to Engineers operating small electric light plants," written by Prof. E. P. Roberts and W. B. Stewart. This excellent little manual will be found very useful by those for whom it is intended and the price at which it is sold—10 cents—is merely nominal.

A. ALLER, 109 Liberty street, New York, in a 48-page pamphlet, describes a number of engineering specialties for use in manufactories, public buildings, hotels, etc. Among these are included the Korting injectors and jet pumps in numerous forms, noiseless water heaters, steam jet draught improvers, exhaust pipe head, pressure regulators of various forms, Curtis steam traps and water temperature regulators, etc.

J. JONES & SON, 67 Cortlandt street, have taken the agency for the Metropolitan district of the Iona Manufacturing Company. They will hereafter carry a heavy stock of Iona electric lighting goods. A new catalogue has just come from the press, copies of which will be mailed on application, as well as a list of the remaining stock of the defunct Alexander, Barney & Chapin Company.

THE WEBSTER CHEMICAL COMPANY, St. Paul, Minn., manufactures a liquid for coloring lamps, called Crystal Chemical Coloring. The process is simple, consisting of merely immersing the lamps in the solution. Any colored lamp can thus be produced in a few minutes. Among the large users of this process, we are informed, are the Chicago Edison Company and the Westinghouse Electric and Manufacturing Company.

THE NORWICH INSULATED WIRE COMPANY, 44 Broad street, New York, has issued a handsome 46-page catalogue of the large line of wires and cables of its manufacture. A number of colored cuts is given of various types of cables, and the pamphlet is well printed on a heavy paper of fine quality. Those unacquainted with the construction of cables will find it made very clear by the handsome full-sized cuts referred to.

WHARTON & WILLIAMS is the name of a new firm of electrical engineers and contractors which recently opened an office in Room 102, Liverpool and London and Globe Building, Newark, N. J. Mr. H. M. Wharton, formerly with the United States Electric Company at Newark, and Mr. R. C. Williams, Jr., formerly with the General Electric Company, are the members of the firm. They will engage in a general engineering and contracting business, for which their past experience well fits them.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has erected for the Mather Electric Company a new building 300 by 50 feet, equipped with improved electrical machinery, and a forty-ton electric traveling crane, especially adapted for building large direct connected generators for railway work. The unfinished castings are brought in at one end of the shop, and are loaded on the cars at the other end as finished generators.

THE MORGAN ENGINEERING COMPANY, Alliance, O., has received an order from the Fulton Iron Works Company, St. Louis, Mo., for a 40,000-pound lifting capacity overhead traveling crane, all motions of which are operated by electric motors. The order for this crane was placed after the most careful investigation into the construction of all other cranes of this character built by competitors. The crane is for serving the new erecting shop to be erected.

W. C. STERLING & SON, Monroe, Mich., the well-known cedar pole dealers, are now being rushed with orders, and are shipping to all parts of the United States. Orders have been received from the General Electric Company, Fort Wayne Electric Company, and many other smaller companies, for a large number of car loads, and, notwithstanding the number of orders, good poles for city use are being rushed out, thus keeping up their reputation as prompt shippers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is having a large sale of its standard single push flush switch made up in gangs of from two to a dozen on a single large face plate for special work, where a handsome finish is expected. As the single pole, three-way and commutation switches are all the same size, they can be mounted very symmetrically, several on a single large face plate, and when the plate is finished specially to match hardware or fixtures, a handsome piece of work is secured.

MR. FRANK LEDROLE and Mr. J. W. Taylor, both of Atlanta, Ga., have formed a partnership under the name of the Ledrole-Taylor Company, as hydraulic and electrical engineers. Mr. Frank Ledrole has been engineer at the southern office of the General Electric Company for the past four years, and Mr. Taylor is the able southern agent of the Stillwell-Bierce and Smith-Vaile Manufacturing Company, of Dayton, O. Both men are well equipped and should do well in their new business partnership.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, is announcing to its patrons that it is handling the Kester Monitor arc lamp, representing the F. P. Little Electrical Construction and Supply Company, makers of this lamp in the West. Mr. W. E. Parker has returned to Buffalo, having had this line in charge during the summer months with headquarters with the Metropolitan Electric Company. A stock of these lamps is kept on hand in alternating, direct and constant current, ornamental and otherwise.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., reports the sale of one of their 180-kw. improved new type multipolar railway generators, with complete station equipment, to the Hartford and West Hartford Horse Railway Company, for the Hartford, Conn., power house. The generator is to replace a 200-kw. generator of another manufacture, which, after a two-weeks' attempt on the part of its makers to make it run successfully, was thrown out. In thirty-six hours after placing the order the Mather Electric Company had the road running successfully, they, in that time, having removed the old generator and installed two temporary generators.

H. N. BATES MACHINE COMPANY, 240 Congress street, Boston, in a 160-page catalogue, gives cuts, descriptions and prices of a long line of machinery for the transmission of power, including numerous forms of friction clutch and other pulleys, friction clutch couplings, shafting, hanger, gears, etc. We learn from a note that this company will furnish, without charge, complete plans showing the best and most economical methods of transmitting power; defining the proper location of engines, boilers, pumps, hangers, shafting, pulleys, etc., for electric light stations, mills, factories and all other buildings wherein power is used; and, when the order is placed with them, will send, without expense, draughtsmen, who are experts in the above specialty, to lay out work and to make the necessary drawings.

MR. HENRY B. OAKMAN, 136 Liberty street, has made the following sales of Wenstrom apparatus during the past week: Raymond Oil Company, Franklin, Pa., one 50-kw. generator and motors for same capacity of various sizes; Dunkirk & Fredonia Street Railway Company, one 5-h. p., 500-volt motor; J. C. Frisbie, Fredonia, N. Y., one 2-h. p., 500-volt motor; American Lucol Company, Carteret, N. J., one 70-light 110-volt dynamo; the Standard Silk Company, Phillipsburg, N. J., one 28-kw. dynamo, 110 volts; the Standard Radiator Company, Buffalo, N. Y., one 22-kw., 110-volt dynamo; the Chapman Derrick & Wrecking Company, Buffalo, N. Y., one 120-light dynamo direct connected to Sturtevant engine; the Wilson Aluminum Company, Spray, N. C., two 100-kw., 70-volt generators.

THE PHOENIX CARBON MANUFACTURING COMPANY, 2134 De Kalb street, St. Louis, Mo., has been organized by Mr. S. G. Booker in connection with some St. Louis capitalists, the capital being $100,000. Mr. Booker was the organizer and the general manager until a short time ago of the Fidelity Carbon Manufacturing Company, controlled by the National Carbon Company of Cleveland, O., which some months since concluded to discontinue manufacturing at St. Louis and moved a large proportion of its machinery to Cleveland. The new firm has bought the plant formerly occupied by the Fidelity Company, and is now busily engaged in remodeling and re-equipping it with the most modern carbon machinery. It will be prepared to start about October 1 with all of the skilled employees formerly with the old company, Mr. Booker continuing in charge of the manufacturing end of the business.

Business Notices

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

ATTENTION is called to the advertisement of the city of Oswego, New York for proposals to light the city for five years. Oswego's water-powers, ready for use, ought to attract bidders. A copy of the specifications can be seen at the office of The Electrical World.

CHARACTERISTICS OF A POPULAR RAILROAD—Travelers find unexcelled accommodations and supreme comfort on the cars of the New York Central Railroad. American railways are noted for the advantages which they afford the traveling public, and there are none that surpass this splendidly equipped road.—"Paper Trade Journal."

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 18, 1894.

(In charge of Wm. A. Rosenbaum, 177 Times Building, New York).

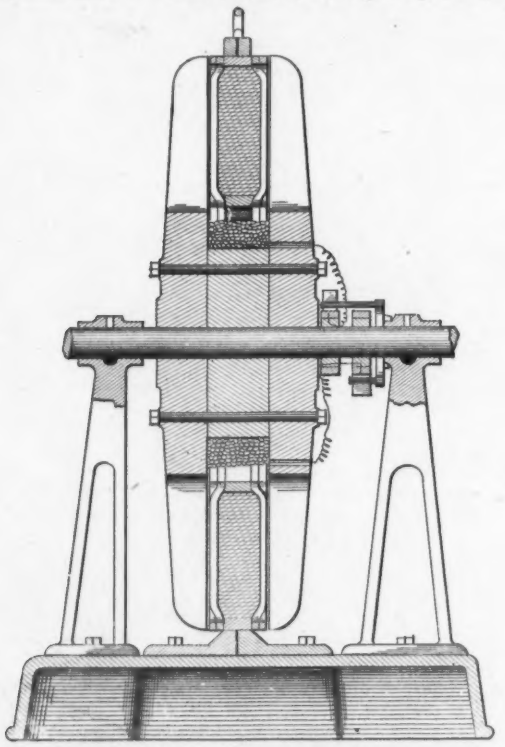
526,063. MULTIPHASE CONVERTER; H. O. C. E. Wagemann, St. Louis, Mo. App. filed July 5, 1892. This comprises a central core part with radially arranged extensions and a separable annular encircling piece fitted to the radial extensions.

526,064. ELECTRIC GENERATOR; H. O. C. E. Wagemann, St. Louis, Mo App. filed July 5, 1892. In an alternating current dynamo the arrangement of armature coils consisting in a plurality of independent coils equally divided on each side of a disk armature and placed circumferentially relatively to each other so as to sub-divide the phases of the machine into a number corresponding to twice the number of coils on one side of the disk armature. (See illustration.)

526,078. ELECTRICAL CONNECTOR; J. B. Henck, Jr., Brooklyn, N. Y., App. filed July 6, 1894. This consists of an inclosing tube, the interior cross section of which is divided into two parts, two pieces of unequal length filling such parts, and a contact making device attached to and within the longer of the pieces, the half of the circumference of the inclosing tube next to and around the longer piece being cut away through a portion of its length and the opposing half forming, with the longer interior piece, a tube inclosing the contact piece throughout its length.

526,172. ELECTRIC SWITCH: L. Winterhalder, Milford, Conn. Application filed February 17, 1894. The combination with a contact clamp, of a U-shaped spring having bearings on opposite sides of the clamp.

526,179. SIGNAL APPARATUS: J. P. Coleman, Swissvale, Pa. Application filed December 2, 1893. The combination of a signal operating mechanism



No. 526,064. Electric Generator.

detachably connected thereto, and a fluid pressure mechanism controlling the connection between the signal and its operating mechanism.

526,182. GALVANIC CHAIN; F. Fritsche, Berlin, Germany. Application filed May 12, 1894. A voltaic chain consisting of links of zinc and copper connected electrically by links of absorptive material, whereby an electric current is produced when in conjunction with the human body.

526,083. ELECTRIC MOTOR; A. W. Meston, St. Louis, Mo. Application filed August 1, 1892. The combination with the armature of a choking coil or coils secured to and rotating with the armature and means for throwing the coils into the motor circuit. (See illustration.)

526,099. APPARATUS FOR AND PROCESS OF EXTRACTING GOLD OR SILVER FROM ORES; P. Danckwardt, New York, N. Y. Application filed April 2, 1894. This consists in subjecting the ore simultaneously to the action of cyanide of potassium, an alakli sulphide and to electrolysis.

526,139. TELEPHONE TRANSMITTER; H. L. Baldwin, Chicago, Ill. Application filed January 30, 1892. The combination of a horizontal bar electrode, a series of electrodes suspended by separate arms from a horizontal rod, adjustable in position by means of slots and clamping nuts.

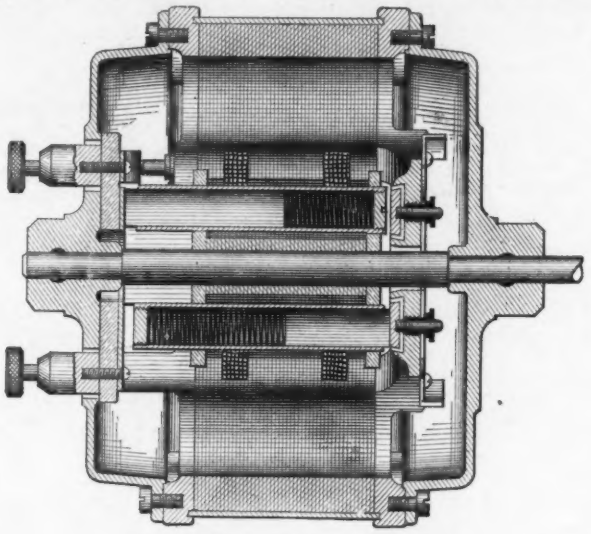
526,141. PNEUMATIC TUBE FISHER; W. C. Bloomer, Brooklyn, N. Y. Application filed April 10, 1893. The combination in an insulating tube fisher of a vacuum pump, flexible connection tubes and a rigid tube and dart.

526,142. BOND FOR ELECTRIC RAILWAYS; D. D. Book, Brooklyn, N. Y. Application filed July 14, 1894. A rail provided at or near its end with a metallic projection or bond plate forming an integral part of the rail.

526,145. INCANDESCENT ELECTRIC LAMP; D. J. Cartwright, Boston, Mass. Application filed January 27, 1894. A socket having an extension provided with a plug fitted to serve as an internal contact, and an internal contact consisting of a screw having its inner end in engagement with the plug.

526,169. ELECTRIC MOTOR; E. Thomson, Lynn, Mass. Application filed August 30, 1884. The combination with a motor, of a stopping switch, a detent therefor, and devices responsive for changes in the speed of the motor for controlling the detent, whereby the switch may be released to stop the motor at a predetermined increase in the speed.

526,168. SIGNAL APPARATUS; G. L. Thomas, Brooklyn, N. Y., and E. C. Seward, Montclair, N. J. Application filed January 22, 1894. This comprises a plurality of circuit making and breaking devices, a track treadle for each movable contact piece under the control of the treadles to close



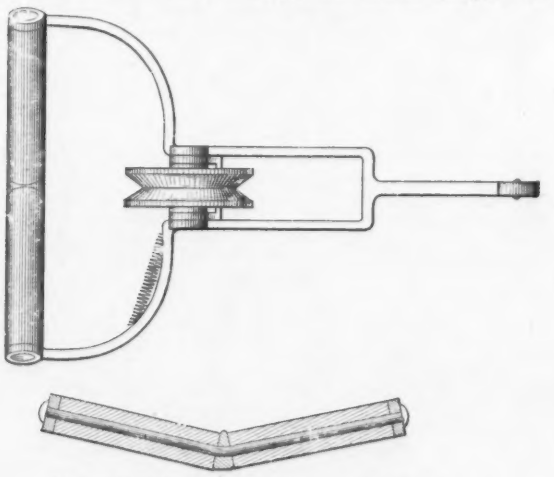
No. 529,083. Electric Motor.

one break in each circuit and movable contact pieces indirectly under the control of the treadles to close a second break in each circuit.

526,170. DYNAMO ELECTRIC MACHINE; D. H. Wilson, Chicago, Ill. Application filed August 17, 1893. The combination in one machine of a motor and generator, the armatures of which are fastened to the same shaft, the field magnets of the same motor and generator being magnetically connected but electrically entirely separated from each other.

526,183. TROLLEY WIRE FINDER; E. Gale, Peoria, Ill. Application filed November 21, 1892. This comprises a grooved contact wheel and revoluble finder sleeves extending laterally beyond the vertical sides of the contact wheel. (See illustration.)

526,220. ELECTRIC INDICATOR; C. J. Coleman, Chicago, Ill. Application filed December 8, 1893. The combination of a standard cell, a current measuring instrument, a variable resistance and a thermometer, the shank of



No. 526,183. Trolley Wire Finder.

which incloses the resistance, the degree of such resistance varying with the degree of immersion thereof in the mercury of the thermometer.

526,227. ELECTRIC CUT-OUT; E. E. Hirsh, Denver, Col. Application filed March 7, 1894. This comprises a revoluble cylinder, a series of fuse wires, contact springs, and means for engaging the free ends of the contact spring to prevent backward movement of the cylinder.

526,356. DIAL TRANSMITTER; F. Pearce, New, York and J. Broice, Brooklyn, N. Y. Application filed June 11, 1894. This comprises a rotary circuit closer and numerous circuits into which the circuit closer directs currents in succession two or more dials and their rotating and circuit closing devices and automatic mechanism for bringing the second dial mechanism into action after the first dial has completed its movement.